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CENTRAL MISSOURI RIVER WATER QUALITY INVESTIGATION, 1954

Public Health Service
Kansas City, Missouri

August 1955

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CENTRAL MISSOURI RIVER WATER QUALITY INVESTIGATION 1954

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MISSOURI DRAINAGE BASIN
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CENTRAL MISSOURI RIVER WATER QUALITY INVESTIGATION

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MISSOURI DRAINAGE BASIN

KANSAS CITY, MISSOURI

AUGUST, 1955

TABLE OF CONTENTS

	Page
SUMMARY	1
FORECASTS	4
RECOMMENDATIONS	8
INTRODUCTION	10
1954 Operations	10
Acknowledgments	11
PRESENTATION OF DATA	13
Climatological Features	13
Physical Features	13
Reservoir Operations	13
Discharge	14
Temperature	15
Turbidity	16
Chemical Features	17
Hydrogen Ion Concentration	18
Alkalinity	19
Monocarbonate	19
Bicarbonate	19
Hardness	22
Oxygen	26
Nitrogen	28
Organic Nitrogen	29
Other Nitrogen Compounds	30
Phosphorous	30
Discussion of Chemistry	30

Biological Features 32

Plankton 32

Qualitative Features 32

Quantitative Features 33

River Reaches Downstream from Fort Randall Reservoir 33

River Reaches Downstream from Garrison Dam 35

Discussion of Biological Features 37

Fort Randall Reservoir 37

Garrison Reservoir 40

The Niobrara River 41

Taste and Odor Occurrences 41

Reservoir Influences upon Water Treatment Costs . . . 42

Text Figures and Tables:

Figure 1 . . . . . following page 10

Figure 2 . . . . . following page 14

Figure 3 . . . . . following page 20

Figure 4 . . . . . following page 24

Figure 5 . . . . . following page 26

Figure 6 . . . . . following page 34

Figure 7 . . . . . following page 42

Table 2 16

Table 2a 17

Table 4 20

Table 5 21

Table 6 22

Table 15 36

Table 16 39

Table 17 40

Table 18 41

APPENDIX 44

Table 1 I

Table 3. II

Table 7 III

Table 8 IV

Tables 9 and 10 V

Table 11 VI

Table 12 VII

Table 13 VIII

Table 14a IX

Table $14b_1$ X

Table $14b_2$ XI

Table $14b_3$ XII

Table $14c_1$ XIII

Table $14c_2$ XIV

Table $14c_3$ XV

Table $14d_1$ XVI

Table $14d_2$ XVII

Table $14d_3$ XVIII

Table $14e_1$ XIX

Table $14e_2$ XX

Table 14e[3] XXI

Table 14f[1] XXII

Table 14f[2] XXIII

Table 14f[3] XXIV

Table 14g[1] XXV

Table 14g[2] XXVI

Table 14h XXVII

Table 14i[1] XXVIII

Table 14i[2] XXIX

Table 14j[1] XXX

Table 14j[2] XXXI

Table 14k[1] XXXII

Table 14k[2] XXXIII

Table 14m XXXIV

Tables 19 and 20 XXXV

SUMMARY

Reported herein are results of the 1954 continuation of an investigation conducted by the Missouri Drainage Basin Office, U. S. Public Health Service, in cooperation with the Missouri River Division, Corps of Engineers, the State Health Departments of Iowa, Nebraska, South Dakota, and North Dakota, and water works personnel at Council Bluffs, Iowa; Omaha, Nebraska; Yankton, Chamberlain, and Mobridge, South Dakota; and Bismarck, and Mandan, North Dakota. The study has been described in a previous report (Central Missouri River Water Quality Investigation, August 1952 - December 1953); and on July 1, 1954, it was extended to include Garrison Reservoir, North Dakota, whose impoundment began in December, 1953.

Operation of the additional reservoir permitted further stream regulation in 1954; and longer river reaches were subjected to water quality modifications associated with impoundments. Improvement of water quality proceeded along lines of hardness, alkalinity, and turbidity reduction, but biological impairment again resulted from algal growths.

Discharge and turbidity relationships were reminiscent of those described for a previous phase of the study (August 1952 - December 1953), but effects of reservoir regulation were more prominent and covered longer river reaches. All regular stations average considerably lower in turbidity, and evidences of reservoir induced turbidity reduction occurred 544.5 river miles below Fort Randall Dam.

Chemical features again varied with seasonal phenomena; and impoundment modifications continued to afford hardness and alkalinity reduction. Reservoir operation failed to offset certain native river

trends in seasonal variation.

Mineral increases originating in leaching of newly inundated soils were evident in Fort Randall Reservoir, particularly during the period March - July, 1954.

Phytoplankton influences upon water chemistry — photosynthetic reduction of carbonate, oxygen supersaturation, etc. — were most noticeable during the first six months of 1954. Spring and fall plankton maxima were developed in and below Fort Randall Reservoir, but they failed to attain density levels reached by the late summer bloom in 1953. Heavy local rains apparently dissipated the spring plankton growth.

Garrison Reservoir differed from Fort Randall both in seasonal composition and abundance of plankters although its influences upon physical and chemical water quality were generally in accord with those recorded at Fort Randall Reservoir. The type of plankton population developed in Garrison, while noted to extend downstream into the headwaters of Fort Randall Reservoir, was not observed to affect the plankton composition of the lower impoundment. Garrison Reservoir developed no dense plankton concentrations during the warmer months, but possessed a rapidly increasing population at the end of the year.

Special procedures for taste and odor control were mainly restricted to the Yankton, South Dakota, treatment plant, where advance notice of impending algal increases permitted operators to institute control measures in time to prevent occurrence of unpalatable odors and flavors in finished water.

Mandan and Bismarck, North Dakota, and Mobridge, South Dakota, are now in regions of constant influence by Garrison Reservoir. Water quality changes also extended down to Chamberlain, South Dakota, where the river

was incorporated into Fort Randall Reservoir in November. No noteworthy taste and odor problems were reported at water plants situated between the two reservoirs.

Decrease in hardness and turbidity concentrations proceeded below the points attained in 1953 and continued to reduce water treatment costs at Yankton, South Dakota, and Omaha, Nebraska.

Forecasts for the immediate future stress the likelihood of taste and odor problems in public water supplies at Mandan and Bismarck, North Dakota; Mobridge, Chamberlain, and Yankton, South Dakota. On a long-term basis, reservoirs are expected to continue present demineralizing trends, although temporary interruptions may result from leaching of inundated soils and chemical stratification. Reservoirs are also expected to generally proceed along individual courses with respect to plankton development.

The investigation should be continued until opportunity exists for study of more stable reservoir conditions. Firmer establishment of lentic environments will permit closer evaluation of reservoir processes and operational procedures, and so aid in understanding of general river conditions to be expected in the future. Additional study is also desirable with reference to determination of plankton levels likely to produce taste and odor problems at various localities, general influences of water quality changes upon water treatment, and possible downstream extension of troublesome algal growths following completion of Gavins Point Reservoir.

FORECASTS

Before entering into forecasts of future conditions it appears appropriate to review predictions made in the first report and the extent of their realization in 1954.

For Fort Randall Reservoir:

A mineral increase predicted from leaching of soils in newly inundated areas was evident from March to July. A heavy initial plankton bloom listed as probable for 1954 failed to occur. Reservoir stratification was considered barely probable in 1954. It did occur, but was of short duration. A predicted spring plankton maximum appeared on schedule. As was expected, its greatest density exceeded that of the subsequent fall growth. The spring population was dissipated by heavy rains before its potential was fully realized. A forecasted heavy plankton growth in upper shallower regions in the vicinity of Chamberlain failed to occur, as the reservoir did not reach that region until November.

For Garrison Reservoir:

Garrison was expected to alter water quality in ways similar to those promoted by Fort Randall Reservoir in 1953. These changes were evident, and a better quality water was furnished water plants at Mandan, Bismarck, and Mobridge. Taste and odor difficulties expected at those plants in summer or fall failed to develop. The error of this prediction resulted from underestimation of the reservoir's potential for individuality. This impoundment humbled the prognosticators by developing its greateast observed plankton density at a time when reduced concentrations appeared in Fort Randall Reservoir. Garrison's exhibited individuality with respect to composition of seasonal growths was expected.

The general forecast that no marked uniformity may be expected over the entire developed reach of the river was borne out by events of 1954.

Predictions of future events at this time, like those made in 1953, must be qualified with respect to certain probable developments. So far, reservoir operation has not effected a reversal or noteworthy modification of natural river trends with regard to seasonal variation of certain dissolved substances such as carbonates, etc. Significant changes have occurred in annual discharge patterns, turbidity loads and concentrations, and plankton growth.

If volumes of water entering and leaving reservoirs are permitted to increase in late summer, as has been the practice the past two years, it appears that the river will be largely deprived of softening benefits that would accrue from storage of seasonal discharges with lowest mineral content. Hardness and alkalinity reduction stemming from factors other than dilution with low mineral content water should continue to provide improvement in water quality on a long-term basis; although reversals are likely to occur from increases due to soil leaching in impoundment areas. In a few years, if any degree of stability in reservoir levels is possible, the tendency to bring minerals into solution from inundated soils should decline. In the immediate future, however, this action is apt to interfere with estimation of mineral loss by precipitation, and may, for a few months each year, result in hardness and alkalinity increase within reservoirs.

Reservoir stratification will also tend to temporarily augment mineral content of discharged water, providing at the same time certain nutrients that may accelerate algal growth in downstream river reaches.

Stratification is not expected to occupy the entire periods of open water seasons during the next two years; but its appearance and longer duration are to be expected with increasing reservoir depths.

With respect to alterations in dissolved mineral content of river water, it seems that similar results are to be expected of both Fort Randall and Garrison Reservoirs, although some variation may be induced by mineral increase within the impoundments.

Each body of water may continue its own pattern with respect to seasons when greatest plankton density occurs and also with regard to composition of dominant growths; however, the reservoirs may not differ very greatly in plankton composition on an annual basis, as typical Missouri River forms should generally achieve dominant positions in each. As lentic conditions become more stabilized, dominance during certain seasons may pass to groups that were either lacking or poorly represented in preimpoundment days.

Five water treatment plants, Mandan and Bismarck, N.D.; Mobridge, Chamberlain, and Yankton, S.D., draw supplies from river reaches in which impairment of biological water quality may be expected at certain seasons. Mobridge now has a less critical position than the other four. The Chamberlain intake is situated in the upper shallow region of Fort Randall Reservoir in which dense algal growths may be anticipated. The other intakes will be affected by the quality of water discharged through dams. In the past, plankters have multiplied between Fort Randall Dam and Yankton; and to date Mandan has exhibited a slightly greater average density than the river immediately below Garrison Dam. These facts are not interpreted to indicate that biological water quality at treatment plants below dams will always closely resemble that of reservoir

discharges, since modifications could result from tributary inflow and other factors. However, on an annual basis it would appear that the cities of Mandan, Bismarck, and Yankton may expect algal taste and odor problems. Advance warning of pending increases should prove of considerable benefit to water treatment.

RECOMMENDATIONS

The investigation should be continued until there is some opportunity to evaluate reservoirs under more stable conditions of existence. It appears that future years will afford this chance and be more productive of information with regard to the general long-term trend of water quality modifications. To date reservoir operation has had a decided bearing on the over-all water quality picture, and it is hardly possible at this time to accurately predict effects of operational procedures under future conditions of increased storage. Data now accumulated do not afford a sufficient background to permit much insight into probable plankton conditions at water treatment plants influenced by Garrison releases or upstream extension of Fort Randall Reservoir.

Continuation of the study will:

a. Supply advance warning of impending biological water quality problems to water operators, and so permit instigation of control measures prior to occurrence of tastes and odors.

b. Evaluate algal densities associated with water treatment plant operational difficulties at various municipalities.

c. Provide data on more stable reservoir conditions and effects of reservoir operation in the presence of greater volumes of stored water.

d. Permit observation of the effects of impoundment of Gavins Point Reservoir and possible downstream extension of biological water problems to Omaha.

e. Allow some estimation of the influences of Oahe Reservoir.

f. Contribute to a fund of information that will serve as a basis for forecasting general river conditions to be expected after all reservoirs are completed and their operation integrated.

The study should proceed along established lines with sampling at additional reservoir stations to provide more data for estimation of certain quantitative effects. Evidences of turbidity reduction at the Kansas City, Kansas, water plant indicate the desirability of observation to determine the extent of reservoir promoted water quality changes and their effects upon water treatment procedures and costs at selected localities downstream from Kansas City.

INTRODUCTION

This report presents information acquired during the 1954 continuation of an investigation begun in 1952. Earlier phases of the study (August 1952 - December 1953) were covered in a report issued in April 1954, which was mainly concerned with Fort Randall Reservoir and events occurring in certain river reaches before and after its impoundment. General limnological phenomena operative in the river were also considered, and various relationships having a bearing on water quality were described and discussed.

In 1954, the study was extended to include another reservoir — Garrison — in early stages of impoundment. This impoundment and the upstream extension of Fort Randall Reservoir brought additional water treatment plants (Chamberlain and Mobridge, South Dakota; Bismarck, and Mandan, North Dakota) into areas of reservoir influences. Locations of these plants and various sampling stations may be noted in Figure 1.

1954 Operations

Garrison Reservoir impoundment began in December 1953, and stations in, below, and above it were established in July. Samples were also collected at Mandan, North Dakota, Mobridge, South Dakota, and Council Bluffs, Iowa. A Public Health Service biologist was stationed at Pickstown in August 1954 to conduct field and analytical phases of the study. Laboratory chemical analyses for North Dakota stations were performed by the North Dakota Department of Health Laboratory, and the South Dakota State Department of Health Laboratory continued to analyze samples from river reaches within that State. Routine sampling in and just below Garrison and Fort Randall Reservoirs was provided by the Corps of Engineers. Local water departments handled sampling at Mandan, Chamberlain,

CENTRAL MISSOURI RIVER
GENERAL REFERENCE MAP

FIGURE 1

Yankton, Omaha, and Council Bluffs. Sampling at Pierre, South Dakota, was by the State Department of Health. Daily turbidity, hardness and alkalinity records covering the past two years were provided by the water departments at Bismarck, Omaha, and Council Bluffs. Omaha and Council Bluffs water operators also performed the field types of chemical analysis at weekly intervals. Biological analyses, other field chemical analyses, and additional sampling were accomplished by the Public Health Service.

Biological samples were collected at weekly intervals at Council Bluffs, Omaha, Yankton, below Fort Randall Dam, Fort Randall Reservoir, Chamberlain, Mandan, below Garrison Dam, and Garrison Reservoir. At Pierre, Mobridge, and above Garrison Reservoir sampling was monthly or semimonthly. Laboratory chemical analyses were performed on biweekly samples at all stations except above Garrison Reservoir, where they were at monthly intervals. No laboratory chemical tests were run at Mobridge, and total phosphorous and organic nitrogen analyses were not performed at Omaha. Due to the late start of the sampling program (October 1954), the Council Bluffs data are represented only by plankton records.

Acknowledgments

In addition to items listed in the operations section, the Missouri River Division, Corps of Engineers, contributed financial assistance, furnished information on reservoir operation and other phases, and provided drafting and reproduction services. Waterworks personnel who cooperated in furnishing data and analytical and collection services were: F. B. Jensen, and M. E. Rew, Council Bluffs; F. B. Lasell, and Joseph Erdei, Omaha; R. N. Whiting and William

Wallner, Yankton; A. J. Campbell and Forest Seely, Chamberlain; Don Wessel, Mobridge; William Yegen, Bismarck; and Robert Shaw and Bevan Shaw, Mandan.

PRESENTATION OF DATA

Climatological Features

The year was characterized by the warmest February of record in all States except Wyoming, where temperature was also abnormally high. Ice breakup in South Dakota reaches of the Missouri was a month ahead of its usual schedule - beginning at Yankton on February 15 and proceeding to Mobridge by February 25. Certain North Dakota tributaries became ice-free in February but breakup on the main stem did not occur there until April 7. March was colder than normal in the six-state area providing runoff to the Central Missouri and premature thawing conditions were suddenly slowed. Temperature and precipitation departures from normal on a monthly and annual basis appear in Table 1 (Appendix).

Of particular interest to this investigation were heavy local rains in southeastern South Dakota, northeastern Nebraska, and northern Iowa, which elevated river stages and markedly increased turbidity in the reach from Fort Randall to Omaha at times in May and June. Omaha high stages in June were largely caused by discharges from Iowa tributaries.

Physical Features

Reservoir Operation

Reservoir operation through December, 1954, is shown in Figure 2. During July, August, and September, Garrison discharges exceeded inflow and permitted accretion of volume in Fort Randall, in which water level elevation gradually increased and extended the reservoir to Chamberlain in early November. Fort Randall inflow was exceeded by discharges in April, July, and December. Maximum elevation of 1343.0' above sea

level was attained on November 30. By December 31, level had declined to 1341.3' msl. Garrison Reservoir attained its maximum 1954 level of 1739.96' above msl. on December 30.

Impoundment in Garrison put all reaches of the stream from there to Omaha under more or less constant reservoir influences. In 1952 Fort Peck Reservoir was noted to markedly affect discharge and certain phases of water quality during the period (July to October or November) when its releases maintained discharges around 30,000 c.f.s. The upstream position of Fort Peck limited its influences to periods of its greater annual discharge, as lower releases were insufficient to overcome the effects of tributary accretion. Longer lasting influences were made possible by Fort Randall Reservoir, and the stream above it was modified by Garrison Reservoir.

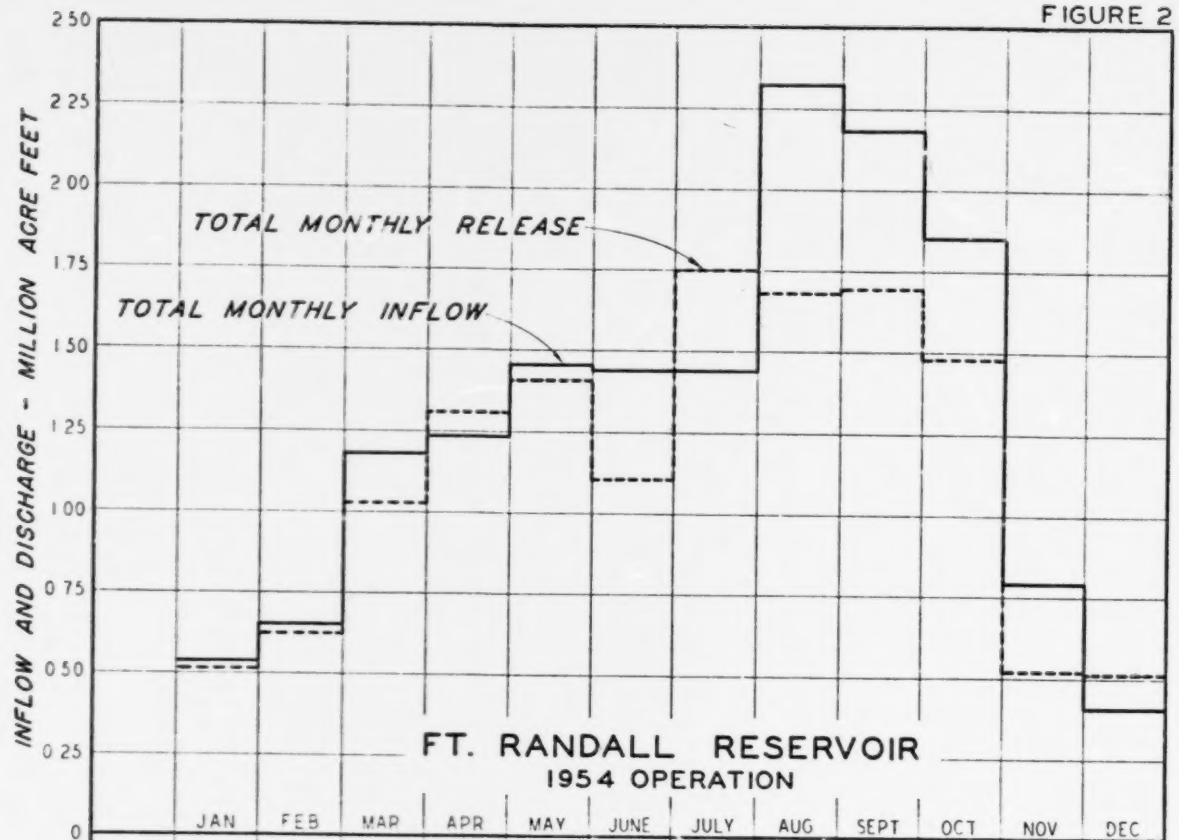
Discharge

Variation in volume of flow at various stations during 1954 may be noted in Figures 3 and 6. Discharge exhibited greater uniformity and failed to attain peaks reached in 1953. The early spring and June rises resulted only in fluctuations of minor magnitude.

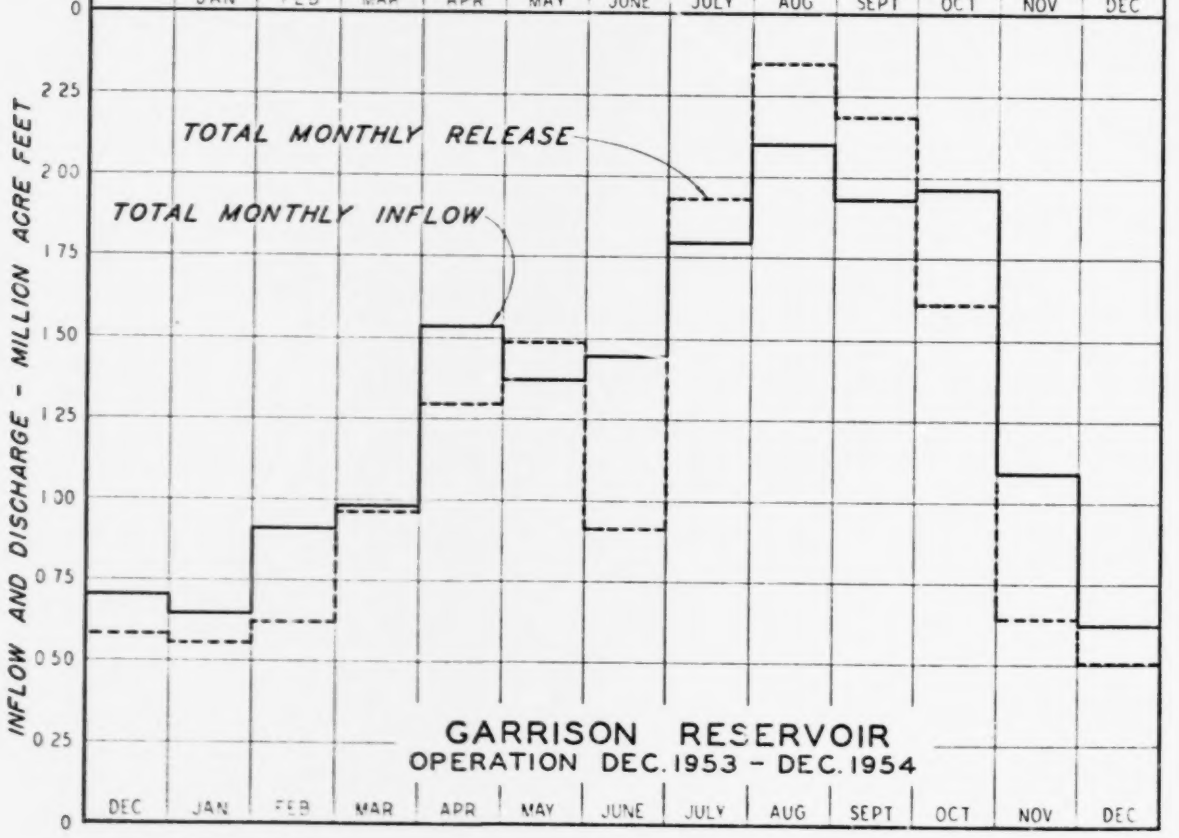
At most stations discharge was largely regulated by reservoir releases. Chamberlain was sufficiently distant from Garrison Dam to permit June tributary inflow to somewhat modify the pattern established by releases from the reservoir. Accretion below Fort Randall Dam was sufficient to permit a more noticeable variance at Omaha. Heavy local rains were responsible for the low rise at Yankton in June.

It may be noted (Figures 2 and 3) that 1954 reservoir operation was mainly responsible for curtailment of the June rise. Discharge from July through September was largely at the expense of water

FIGURE 2



FT. RANDALL RESERVOIR
1954 OPERATION



GARRISON RESERVOIR
OPERATION DEC. 1953 - DEC. 1954

accumulated in Garrison Reservoir. Garrison was allowed to gain volume from October through December, but Fort Randall suffered volume loss in December. Releases from both reservoirs were at a minimum during the last two months of the year.

Fort Peck Reservoir releases, of noted influences at all stations during 1952 and at points above Fort Randall Reservoir in 1953, were influential in the discharge picture only above Garrison Reservoir in 1954.

Similarity of discharge patterns noted at all stations for the period August 1952 - December 1953, was evident to a lesser extent in 1954.

Temperature

Water temperatures appear in Table 3 (Appendix). Seasonal variation was similar at all stations. Minimum temperatures ranged from 0 to 3 °C., while maximums varied from 17 - 27 °C. It is believed that higher maximums would have been recorded at more northern stations if measurements had been made in July. Discharged water temperatures at most seasons differed little from those of reservoir surfaces. Fort Randall discharges were at times either warmer or colder than reservoir surface waters. Measurements made below the dam are not truly representative of water temperatures near the reservoir bottom, as discharged water soon lost or gained heat to or from the atmosphere.

Dissolved and suspended solids were not sufficiently concentrated in lower levels to give a density increase that would permit colder water to occur at the reservoir surface when temperatures were above 4 °C.

Turbidity

Turbidity levels at daily or weekly intervals appear in Figure 6. At all sampling points, except Omaha, maximum concentrations fell far below those noted in previous years. Average 1954 concentrations were lower than those of 1953 at all points of record (Table 2).

Table 2. Average Turbidities in ppm.

	1953	1954
Omaha	827	545
Yankton	419	124
Below Fort Randall Dam	166	25
Chamberlain	1,782	390
Pierre	1,046	260
Bismarck	957	89

The 1954 maximum noted at Omaha (9,600 ppm.) represented the only occurrence within that general range, whereas in 1953 the same general level (maximum 8,000 ppm.) was attained upon six occasions. The 1954 pattern at Omaha, although of lower average range, was essentially the same as that exhibited in 1953 — marked by general uniformity after July 1 and showing considerable variation over the period of frequent stage changes enduring from late winter through June.

Turbidity showed no marked uniformity at any point other than immediately below reservoirs. A downstream increase was evident below each reservoir, but turbidity buildup was at a slower rate below Garrison than below Fort Randall Reservoir. The Niobrara River enters the Missouri between Fort Randall and Yankton, and construction activities at Gavins Point Damsite may have again had some bearing upon the turbidity picture. Turbidity increase immediately below Fort Randall Dam in June occurred

after a 1.02 inch rain.

Records made available by A. W. Rumsey, Chief Chemist, Kansas City, Kansas, Water Treatment Plant, indicate that turbidity reduction has extended to that locality, approximately 544.5 river miles below Fort Randall Dam. Annual averages from 1918 to 1954 appear in Table 2a. The decidedly lower values for the past two years leave little doubt of reservoir responsibility.

Table 2a. Average Annual Turbidity ppm., Missouri River, Kansas City, Kansas

Year	Turbidity	Year	Turbidity	Year	Turbidity
1918	2329	1931	1812	1944	2052
1919	1820	1932	3162	1945	2085
1920	2549	1933	2857	1946	2330
1921	1837	1934	1668	1947	1450
1922	2477	1935	2303	1948	1849
1923	3264	1936	1654	1949	1450
1924	2208	1937	2692	1950	1870
1925	2162	1938	2304	1951	1890
1926	2203	1939	1933	1952	1308
1927	3251	1940	2110	1953	803
1928	2881	1941	2899	1954	810
1929	2246	1942	2192		
1930	2040	1943	1668		

At stations most remote from reservoirs, turbidity and discharge variation showed the same general direct relationship that characterized unaffected reaches of the river over the 18-month period covered in the previous report — turbidity increases either accompanying or closely following elevations in discharge.

Chemical Features

Methods of analysis were the same as in 1952-53. Alkalinity, pH and hardness data were supplemented by daily records kept by water plant operators

at Council Bluffs, Omaha, and Bismarck. These latter records were used in figures and in average computations for those localities.

Hydrogen Ion Concentration

Variation in pH, like that of some other chemical features, was proportional to frequency of records in most instances. Where only monthly and semimonthly records were available pH was marked by a general uniformity over the first six months (Figure 3). It varied considerably on a daily basis at Omaha, but average monthly levels there were never more than 0.1 pH from those indicated by one or two samples at the next upstream station. Photosynthetic influences upon pH were either not as marked as in 1953 or peaks so caused were missed by the sampling schedule. The highest value (8.5 below Fort Randall Dam) occurred shortly after the peak of the spring plankton maximum. The lowest value (7.8) was noted below Fort Randall Dam during a short period of reservoir stratification in July and at Omaha during high June discharges.

The 1954 pH picture did little to alter impressions gained in 1952 and 1953. The normal pH, influenced by soluble monocarbonates, ranges from 8.1 - 8.3. In most instances elevations above 8.3 are due to photosynthetic activity of plankton algae and decreases to 8.0 and below are occasioned by dilution with large volumes of surface runoff. Below reservoirs values less than 8.0 may occur as a result of thermal stratification, which may usually be expected to increase acidity in deeper layers.

The 1954 pH levels, like those of 1952-53, indicated a rather low level of organic decomposition in the river at the majority of sampling points. No analyses were conducted at Bismarck and Williston where evidences of organic decay were found in 1952 and 1953. The average pH level at Bismarck (data furnished by water operator) varied from 7.7 to 7.8

during warmer months in 1954, and it would appear that phenomena involved in lower pH levels there in summers of 1952 and 1953 were still operative in 1954. As in 1953, pH level rose with the onset of the cold water season.

Alkalinity

Monocarbonate

The relationships of monocarbonate to basin soils and photosynthesis have been described in the first report. In 1954, at most stations, concentrations of monocarbonate above 6 ppm. (a level considered possible from soluble monocarbonates alone) normally accompanied an oxygen supersaturation resulting from photosynthesis (Tables 3 and 9, Appendix). The relationship of monocarbonate and pH were little better defined than has been previously noted, nor did relative intensity of bicarbonate and monocarbonate alkalinity unduly influence pH. Upon one occasion an HCO_3 of 116 ppm. and a CO_3 of 8 ppm. gave a pH of 8.2, while at another time values of 114 and 4 ppm., respectively, were associated with a pH of 8.4. Upon the latter occasion no photosynthetic influences upon oxygen were evident.

Bicarbonate

The annual changes in bicarbonate concentration closely follow the pattern shown for total alkalinity in Figure 3. Relations to various seasons and discharge levels at each station were generally reminiscent of fluctuation described for 1952-53. Highest levels were usually associated with winter low flow conditions, and lowest ranges generally occurred with periods of greatest discharge, or occupied the active photosynthetic seasons that coincided with extended periods of uniform discharge in spring and early summer and again in late summer

and early autumn. At Omaha, where ice cover was not a feature of the 1953-54 winter, the monthly average level was highest in March and April. An isolated peak in June approached the earlier highs, but bicarbonate declined thereafter.

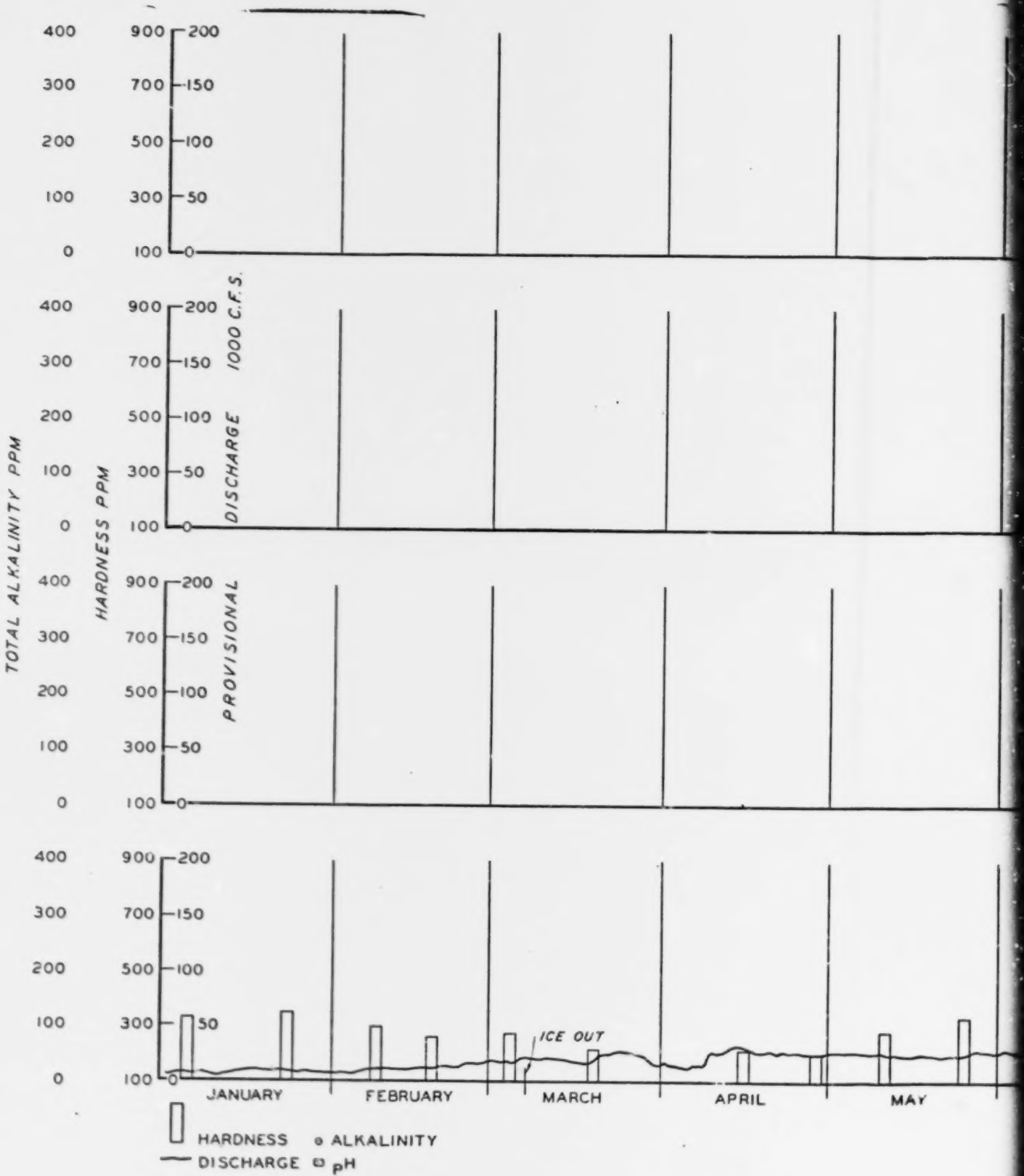
Comparison of 1953 and 1954 average alkalinities (Table 6) shows slightly lower mean concentrations in 1954 at all stations represented in available records. Not much change was anticipated at Yankton and below Fort Randall Dam, but Chamberlain was expected to be within range of the demineralizing influence of Garrison Reservoir, which, however, seemingly did not afford alkalinities of any significantly lesser concentration than those provided by Fort Peck Reservoir during previous years. Average May - September alkalinities at Chamberlain were 10 ppm. lower in 1954 while fall and winter averages were higher than those of previous years.

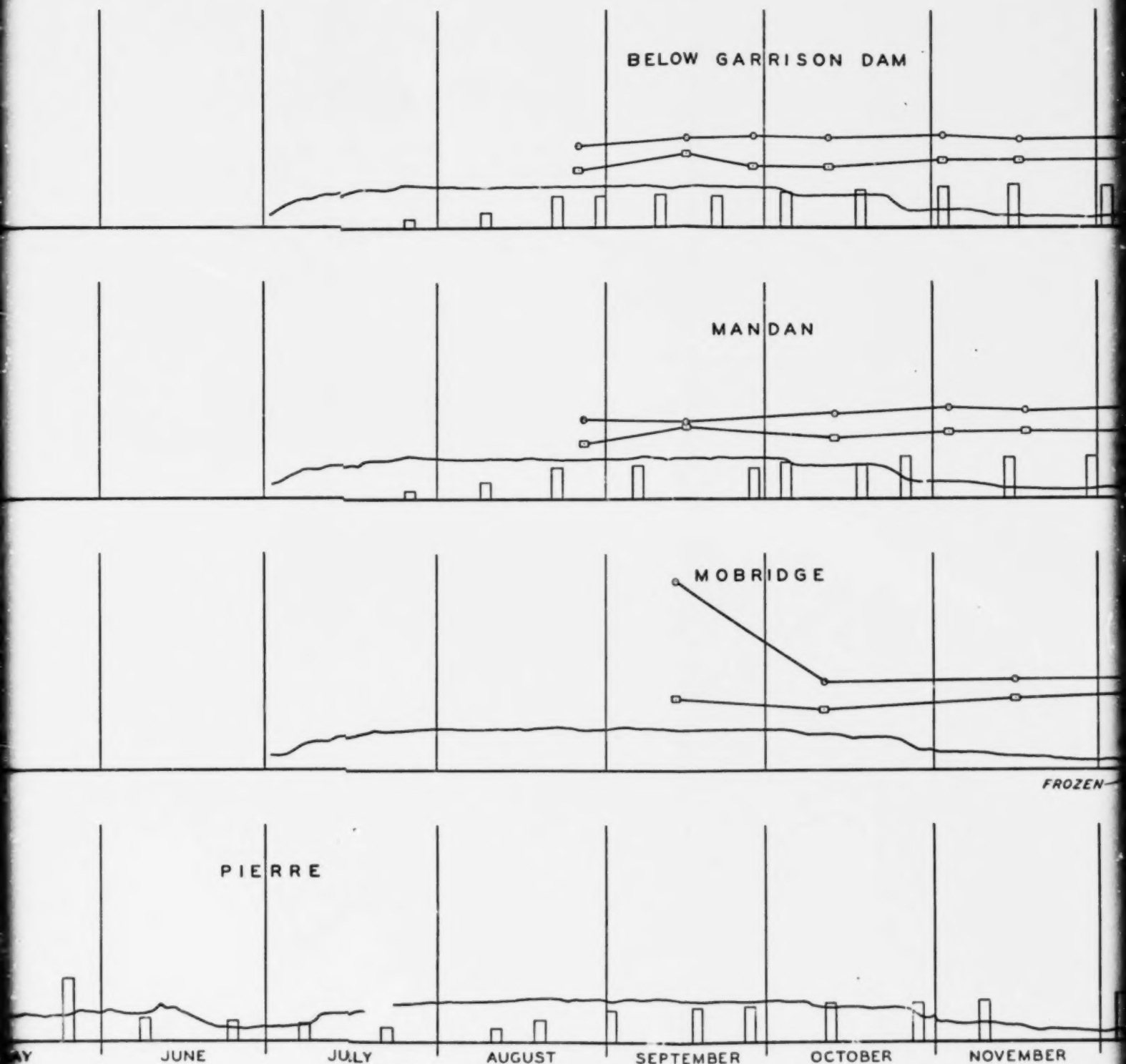
Total alkalinity load was lower at all stations where records permit its computation for the last two years (Table 4). Reduction in total pounds of alkalinity, like decrease in hardness load, appears attributable to reservoir influences.

Table 4. Total Alkalinity Load in Pounds per Annum/

	1953	1954
Bismarck	7.2×10^9*	6.5×10^9*
Fort Randall Reservoir		
Inflow	8.73×10^9	6.42×10^9
Discharge	7.65×10^9	5.28×10^9
Omaha	- -	8.79×10^9* (for 11 mos.)

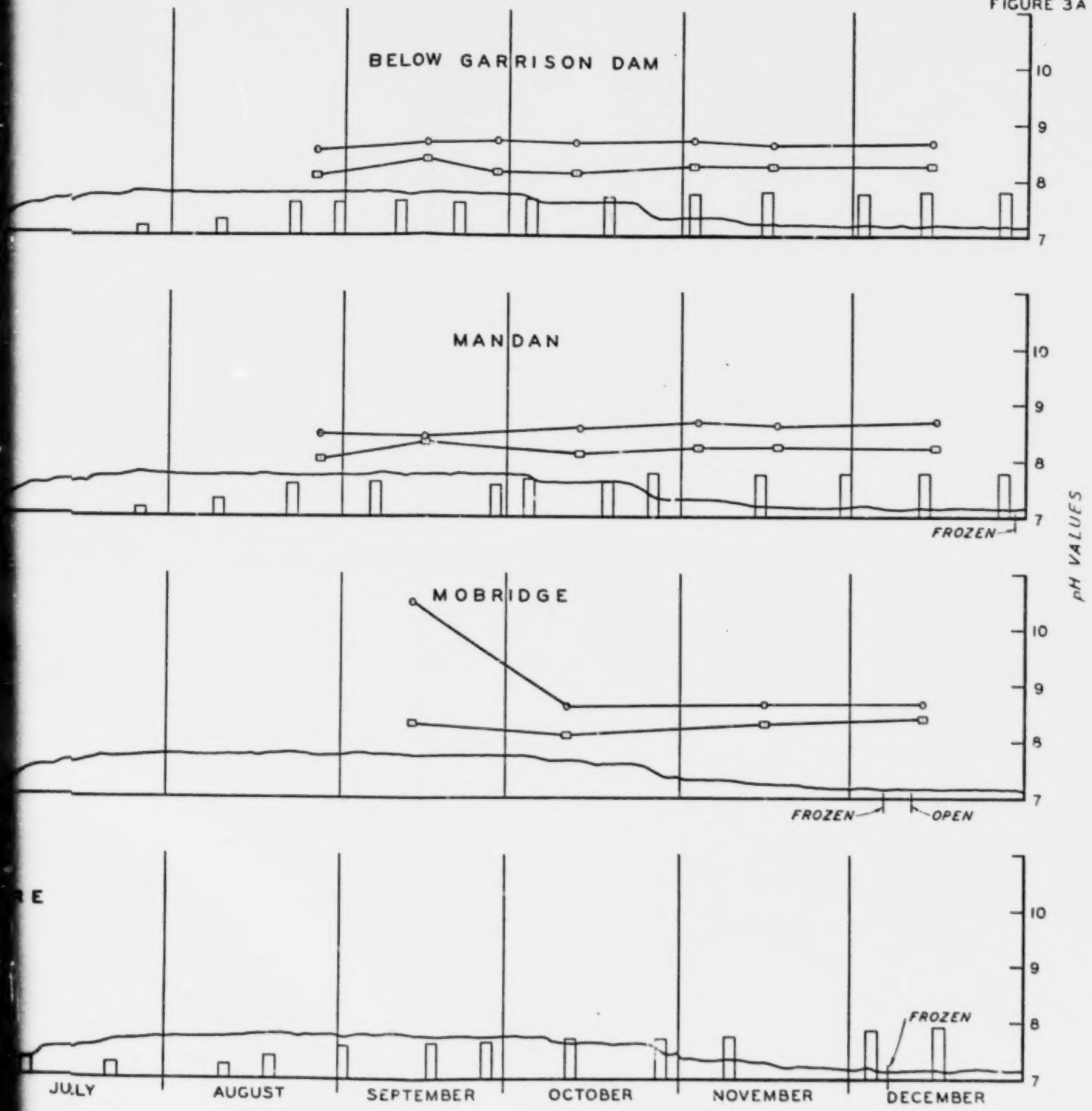
*From daily water department records.
/ Unweighted data based on mean discharge and average alkalinity.


TOTAL ALKALINITY PPM
HARDNESS PPM
DISCHARGE 1000 C.F.S.
PROVISIONAL
400
300
200
100
0
900
700
500
300
100
200
150
100
50
0
ICE OUT
JANUARY
FEBRUARY
MARCH
APRIL
MAY
HARDNESS
ALKALINITY
DISCHARGE
pH



CENTRAL MISSOURI RIVER
HARDNESS, ALKALINITY, pH AND D
JANUARY - DECEMBER 1954

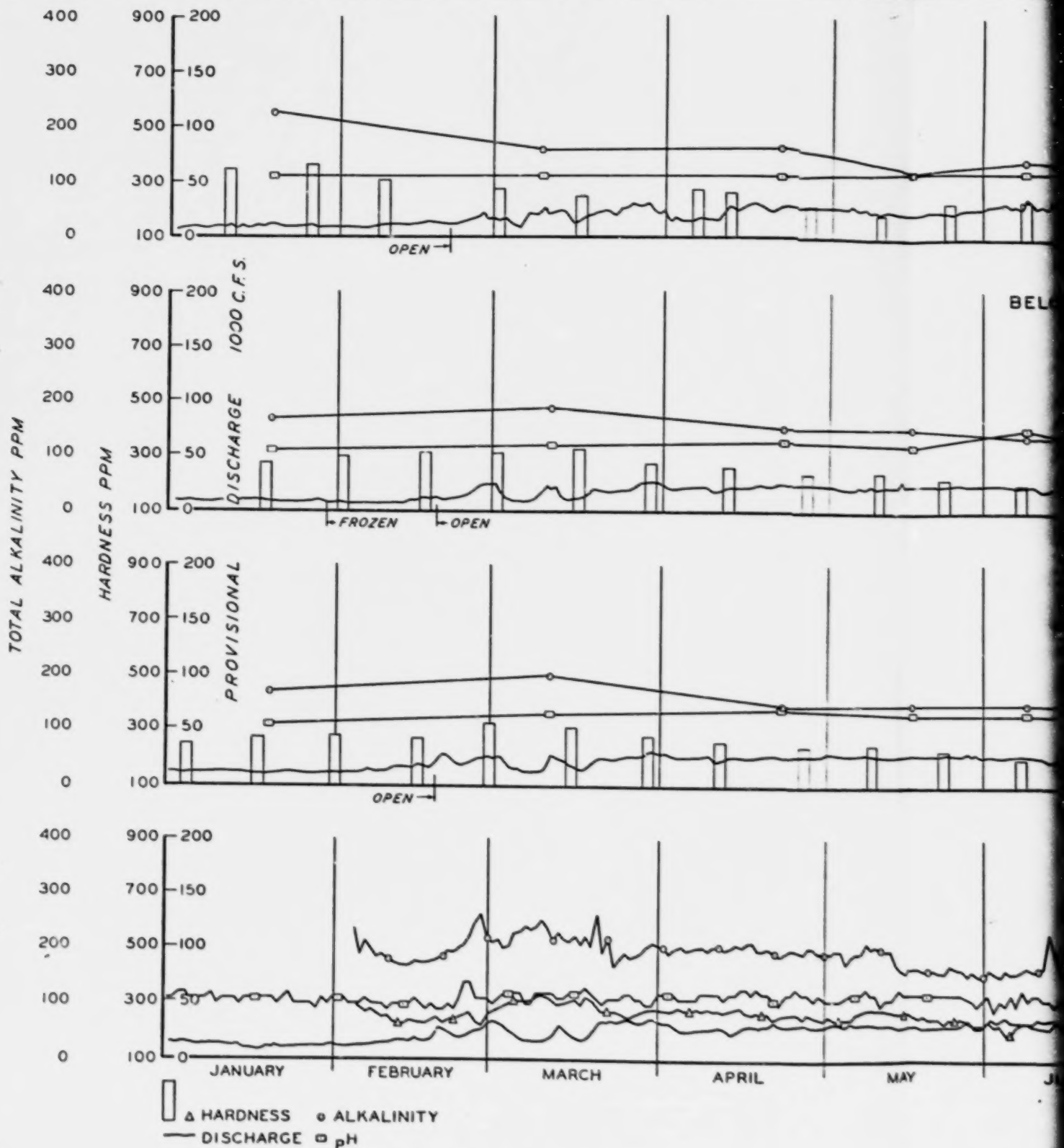
FIGURE 3A

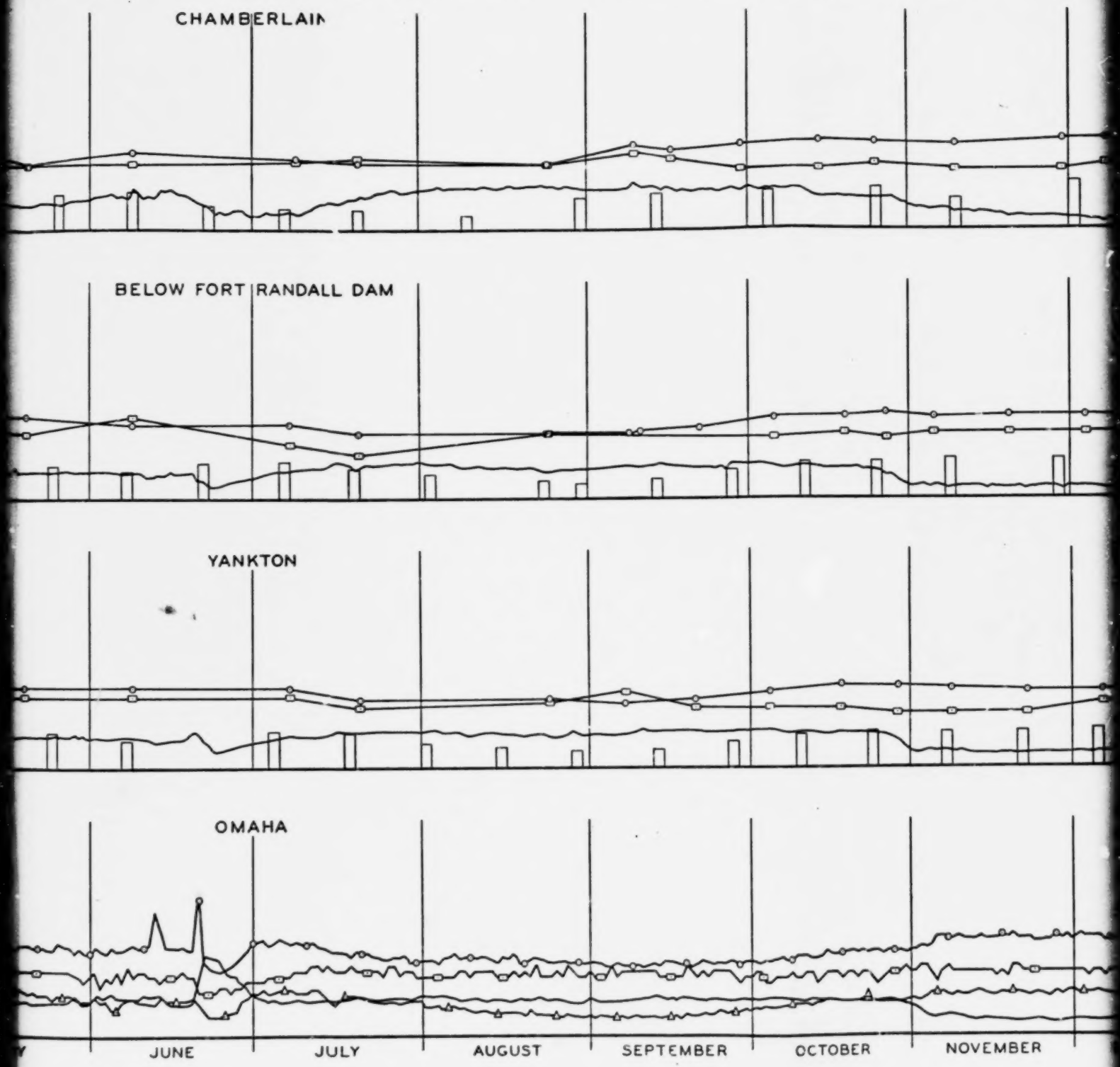


CENTRAL MISSOURI RIVER

HARDNESS, ALKALINITY, pH AND DISCHARGE

JANUARY - DECEMBER 1954


TOTAL ALKALINITY PPM
HARDNESS PPM
DISCHARGE 1000 C.F.S.
400
300
200
100
0
900
700
500
300
100
200
150
100
50
0
OPEN
FROZEN
OPEN
PROVISIONAL
OPEN
JANUARY
FEBRUARY
MARCH
APRIL
MAY
Δ HARDNESS
o ALKALINITY
DISCHARGE
□ pH

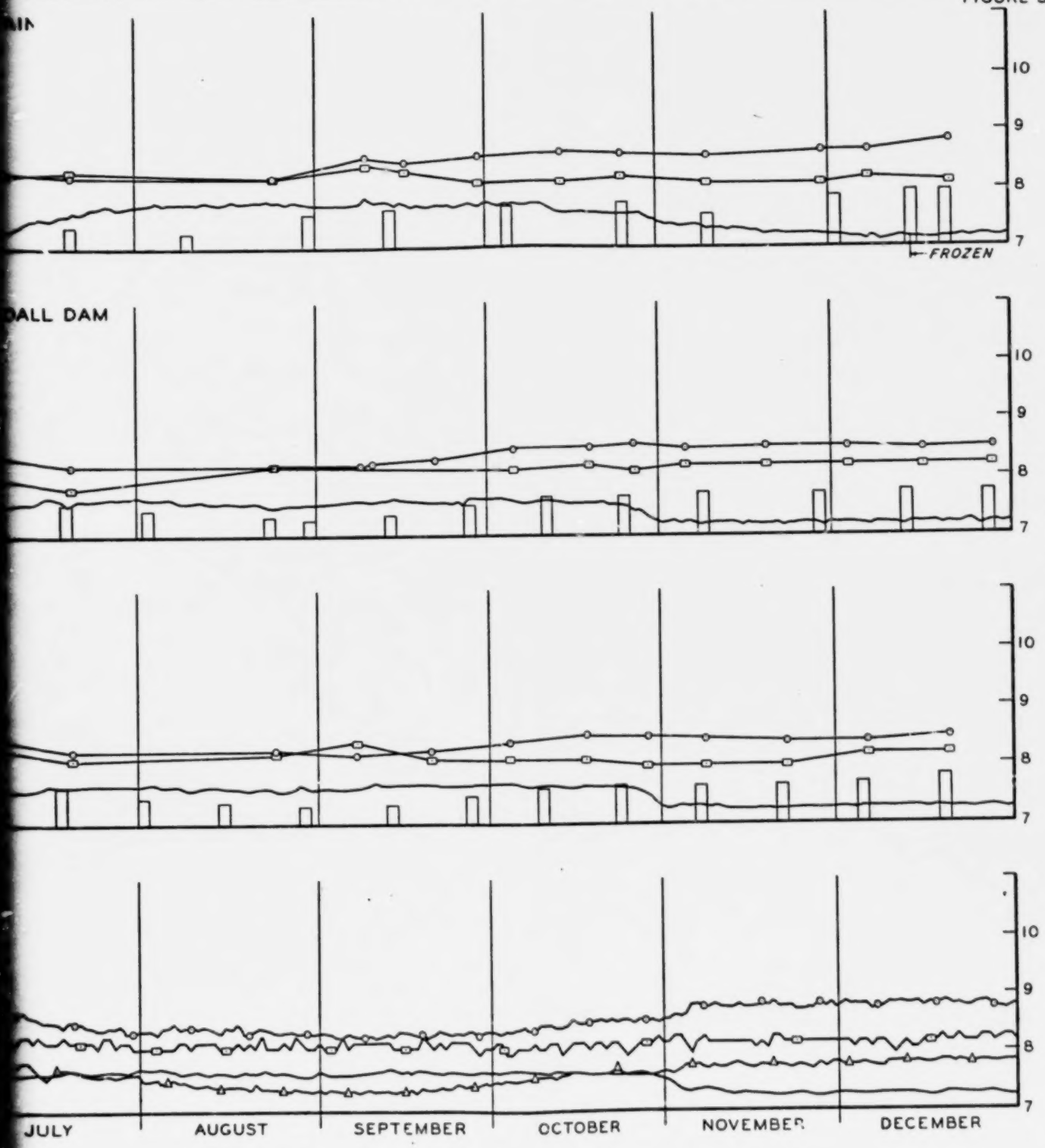


CENTRAL MISSOURI RIVER

HARDNESS, ALKALINITY, pH AND DI

JANUARY - DECEMBER 1954

FIGURE 3B



CENTRAL MISSOURI RIVER

HARDNESS, ALKALINITY, pH AND DISCHARGE

JANUARY - DECEMBER 1954

21-B

The total alkalinity load entering Fort Randall Reservoir each year was in excess of the sum of the load discharged and the quantity retained in impounded water. The differing amount is assumed lost to precipitation largely induced by photosynthesis. Annual alkalinity loads computed on a weighted basis, i.e., the sum of monthly pounds of water times monthly mean alkalinity, indicate that for 11 months each in 1953 and 1954 amounts lost to precipitation were 141×10^6 and 335×10^6 pounds, respectively. Percentagewise, loss was 1.75 and 5.78 percent of the total load entering the reservoir. Annual loads computed by the above method appear in Table 5.

Table 5. Total Alkalinity Load, Pounds per Annum, Fort Randall Reservoir*

	1953	1954
Inflow	8.06×10^9	5.79×10^9
Discharge	7.41×10^9	4.78×10^9
Left in Storage	509×10^6	675×10^6
Unaccounted for (precipitated)	141×10^6	335×10^6

* Does not include February of either year.

Monthly gain or loss and accumulated precipitated alkalinity in Fort Randall Reservoir over the period January 1953 - December 1954 appear in Table 7 (Appendix). Records taken one to three times per month do not accurately represent the quantities involved, but do show the trend of carbonate accumulation in the reservoir. The regression line for this process is shown in Figure 5. Precipitation influences were masked to a considerable extent in 1954 by quantities brought into solution from the impoundment area.

Table 6. Average Total Alkalinity and Total Hardness (ppm.) in 1953 and 1954

Station	Alkalinity 1953	Alkalinity 1954	Hardness 1953	Hardness 1954
Omaha /	-	172 (11 mos.)	261	241 (11 mos.)
Yankton	150	145	264	238
Below Ft. Randall Dam	147	144	259	240
Chamberlain	157	154	271	247
Pierre	-	-	268	231
Bismarck /	160	158	224	211
Below Garrison Dam*	-	158	-	216
Above Garrison Reservoir*	-	169	-	246
Mandan*	-	154	-	218

*July-December records.
/Records furnished by water plant operators.

Hardness

Variation over 1954 appears in Figure 3 and Tables 3 and 8 (Appendix). As in 1953, minimum levels in general followed rather closely on the heels of the "June rise". Lows during this period characterized reservoirs as well as river reaches, and apparently represent an annual phenomenon that impoundments have to date been unable to overcome. The annual minimum appeared to proceed in a downstream direction and its progress was slowed somewhat by Fort Randall Reservoir. Hardness decline was accompanied by an alkalinity loss — a similarity suggesting involvement of carbonate compounds.

In 1953 it was suspected that reduced hardness following a period of increased runoff resulted from a temporary exhaustion of carbon dioxide in soils, which reduced for a time the erosiveness of ground water. No better explanation is available at this time, and the assumption is supported by the fact that the reduction appeared to be restricted to carbonate hardness.

At Omaha a decline in hardness accompanied increased discharge in June, and at all stations maximums appeared during the winter low flow periods. The lack of reservoir influence upon the normal seasonal occurrence of the annual minimums appears related to the operational procedure of stepping up releases in July, August, and September.

Hardness averages for 1954 were significantly below those of 1953 for all stations of record (Table 6). Factors involved in hardness reduction by reservoirs (dilution by retained surface runoff, sedimentation, etc.) have been discussed in the previous report. In the period August - December, average hardness just below Fort Randall was 225 ppm. in 1953 and 212 ppm. in 1954. At Yankton the figures for this period were 222 in 1953 and 209 in 1954. The last five-month period offers a better basis for comparison of reservoir factors than annual records, as impoundment conditions were not well established until late July 1953.

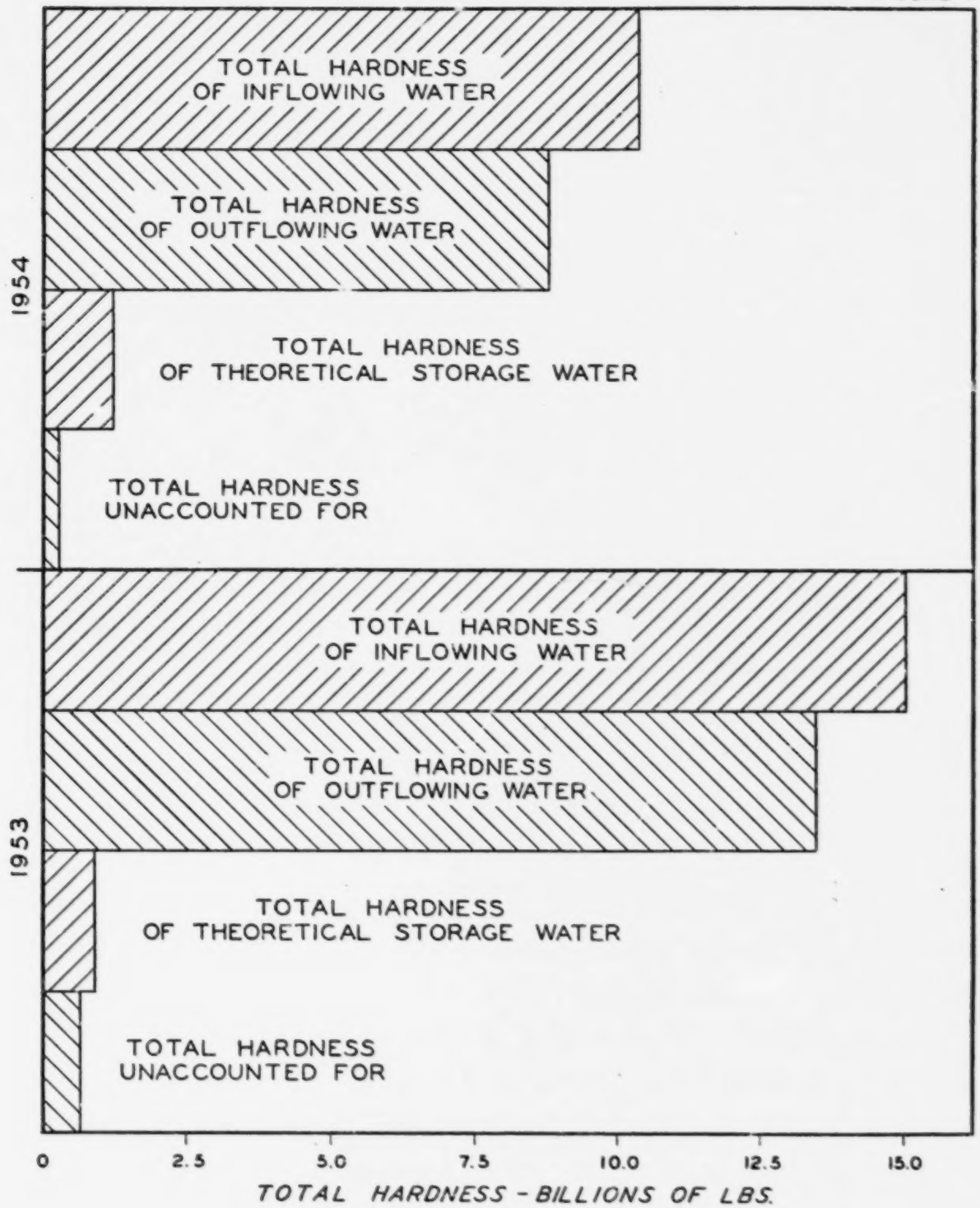
Although average annual concentration was lower, Fort Randall Reservoir discharged harder water than it received from upstream inflow during the period March - July, 1954, (Tables 3 and 8, Appendix). This situation was expected, since it was predicted that the reservoir would increase its mineral content by leaching newly inundated soils as water level raised. Despite this increase the reservoir was still able to reduce the annual average concentration and the total annual hardness load of its inflow. Garrison Reservoir reduced average hardness concentration of its inflow by 30 ppm. during the period of record. At Bismarck, the decrease was to a lesser extent on an annual basis.

Hardness concentration is more significant to water treatment than total annual load. Reduced concentration does not necessarily

indicate a decrease in total load, as increased discharge could effect a lower concentration while moving a greater poundage. Total hardness load may be estimated by relating average concentration to mean discharge and arriving at pounds of hardness on the basis of its concentration in total pounds of water. At Omaha the total load amounted to 16.9×10^9 pounds in 1953 and 12.8×10^9 pounds for the last eleven months of 1954. January 1954 records which are lacking would increase the annual load probably by less than 8 percent, as that month had uniform low discharges. At Bismarck loads for 1953 and 1954 were 10.1×10^9 and 8.7×10^9 pounds, respectively.

Reduction in the total hardness load at Omaha and Bismarck was largely the result of reservoir-reduced concentration. For example, total load below Fort Randall Dam (based on semimonthly records) was 13.5×10^9 pounds in 1953 and 8.8×10^9 pounds in 1954. Average annual concentration was 259 and 240 ppm., respectively. Reduced load below the dam in 1954 was directly associated with a lower concentration. It could be argued that decreased concentration resulted from dilution with retained surface runoff, and that reduction in the total hardness load was due to the quantity retained in impounded water. If decreased load was brought about solely in this fashion, the pounds discharged plus the quantity retained in the reservoir should equal the load brought into the impoundment. In 1953 total inflow was 20,458,660 acre-feet. Total outflow was 19,160,820 acre-feet, which left 1,297,840 acre-feet in theoretical storage. Average hardness concentration of inflowing water (measured at Chamberlain) was 271 ppm., while that of outflowing water was 259 ppm. The mean concentration of water retained in the reservoir was assumed to be the average of inflow and outflow, namely, 265 ppm.

FIGURE 4



CENTRAL MISSOURI RIVER

FT. RANDALL RESERVOIR

HARDNESS LOAD

24.4

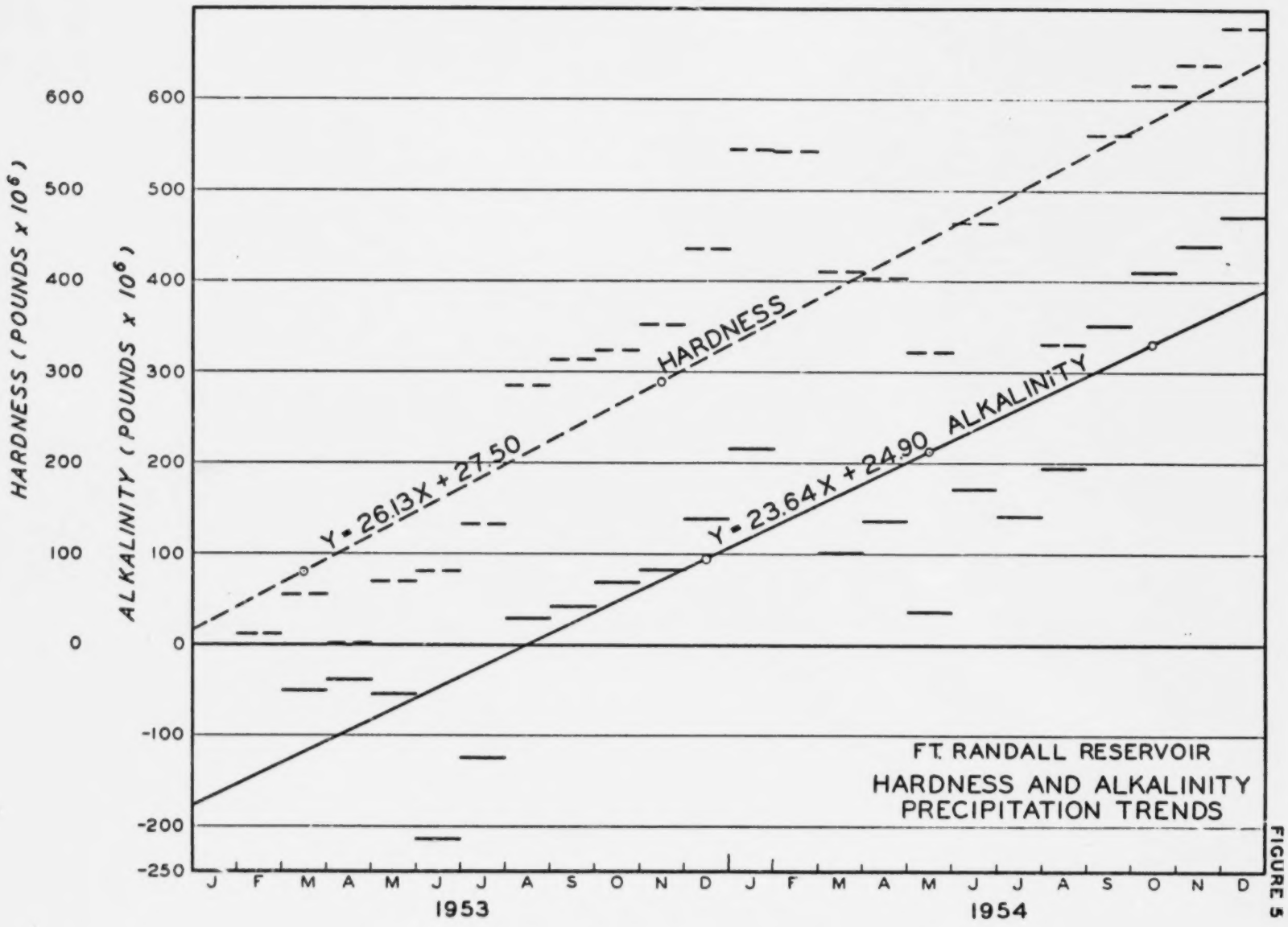
On the basis of these concentrations the inflowing hardness load amounted to 15.07×10^9 pounds per annum, the outflowing load was 13.49×10^9 pounds, and the quantity retained in reservoir water was 934×10^6 pounds. The sum of the last two figures, $14,423 \times 10^9$, is 646×10^6 pounds less than the quantity brought into the reservoir. If it is assumed that average concentration of impounded water is 271 ppm., then the load in theoretical storage amounted to 955×10^6 pounds, and the sum of this quantity and the amount discharged leaves 625×10^6 pounds unaccounted for. It is believed that the average of inflow and discharge is a better figure for reservoir water. A loss of hardness from stored water was also evident in 1954 (Figure 4). Use of Chamberlain records as a measure of inflowing loads gives a conservative picture, since additional hardness enters the river between there and Fort Randall Dam.

Annual loads as given above are not weighted by multiplying daily or monthly concentrations times pounds of water per same interval of time. The purpose of hardness load discussion in this report is indication of the trend toward loss by precipitation, which is shown by estimates based upon average concentrations and mean river discharges. Weighted figures for Fort Randall Reservoir on a monthly basis appear in Table 8 (Appendix). The sums of monthly weighted values for 1953 give inflow and outflow loads of 13.8×10^9 and 12.5×10^9 pounds, respectively. Loads retained in the reservoir and those lost by precipitation were, in that order 834×10^6 and 466×10^6 pounds. The last figure is 3.4 % of the total load entering the reservoir. For the gross method listed in the preceding paragraph, the loss by precipitation amounted to 4.2 % of the total inflow load. Infrequent records and variation

in sample frequency during individual months permit no claim of accuracy other than showing a trend for either method. For purposes of this interim report it is considered unnecessary to compute weighted hardness and alkalinity values on a daily basis at Bismarck and Omaha, as the trend is indicated by the simpler method of calculation. It is realized however that weighted figures would differ somewhat from those given, and would furnish more accurate annual load estimates.

Loss of hardness from solution related to calcium and magnesium precipitation by photosynthesis is normally accompanied by a corresponding loss in alkalinity. Computation of hardness and alkalinity loss or gain in the reservoir on a monthly basis gave the accumulated totals shown in Tables 7 and 8 (Appendix) and the regression lines for accumulation appearing in Figure 5. The parallel nature of these lines suggests that hardness removal was chiefly at the expense of carbonates.

The role of photosynthesis in reducing hardness and alkalinity was rather obscured by the unrelated seasonal carbonate lows that extended from July to September, and by mineral increases attributable to reservoir soil leaching. Reference to Table 3 (Appendix) and Figure 6 will show a loss in hardness and alkalinity concentration in Fort Randall Reservoir during the plankton increase in April, a gain during the algal decline in early May, another loss coincident with plankton increase in late May and early June, and an increase following the June algal recession. The progressive decline in mineral content starting in July was related to the seasonal pattern for the river in general, which prohibits estimation of photosynthetic effects during the late summer plankton maximum. Losses suffered by water retained in impoundments are believed to represent to a large extent photosynthetic induced precipitation. Some


HARDNESS (POUNDS x 10⁶)
ALKALINITY (POUNDS x 10⁶)
600
500
400
300
200
100
0
-100
-200
-250
HARDNESS
Y = 26.13X + 27.50
ALKALINITY
Y = 23.64X + 24.90
J F M A M J J A S O N D J F M A M J J A S O N D
1953
1954
FT. RANDALL RESERVOIR
HARDNESS AND ALKALINITY
PRECIPITATION TRENDS
FIGURE 5

H-72

dissolved mineral loss probably accompanies silt sedimentation by virture of organic particle attraction to calcium and magnesium carbonate.

Sedimentation of carbonate is not unusual in standing bodies of water and historically has resulted in commercially important marl deposits in natural lakes. Its rate of continuance in main stem reservoirs will depend upon condition therein. If chemical stratification occurs, carbonic acid produced in bottom layers will react with settling carbonate and increase the concentration of bicarbonate and thereby the hardness of deeper waters. Under these conditions hardness and alkalinity of discharged water could exceed those of reservoir inflow. The reservoirs may also add to their hardness load in early stages of their existence by leaching minerals from soils of newly inundated areas. If chemical stratification exists for only short periods or fails to occur, the reservoirs should in the long run continue to add to their carbonate deposits.

Prior to reservoir impoundment, hardness at Fort Randall Dam exceeded that at Chamberlain and Yankton as a result of features mentioned in the first report. In early 1954 the river at Chamberlain was subject to softening and dealkalinizing influences of Garrison Reservoir, and its hardness upon occasion was below that of water discharged through Fort Randall Dam. However, its average was considerably greater.

Influences of Garrison Reservoir upon total hardness load may be assumed identical to those of Fort Randall, and largely responsible for the reduction noted at Bismarck. Records for the last four months of 1954 indicate that 147×10^6 pounds were removed by sedimentation during that quarter. Effects of soil leaching in this reservoir have not

been estimated.

Oxygen

Oxygen saturation ranged through the values shown in Table 9 (Appendix). At Yankton and in Fort Randall Reservoir, supersaturation prevailed from January until late summer. Just below the dam supersaturation endured until October. However, unlike 1953, the high oxygen values in the fall had no relation to algal growth, but were occasioned by air drawn through ducts to flood control discharge tunnels. Oxygen so supplied came out in water some distance below the downstream surface, and approximately five river miles were required to reduce concentration to the saturation level. When the flood control tunnels were closed in October and discharge restricted to penstocks, oxygen concentration below the dam closely approached that of the reservoir. Supersaturation in the reservoir and at Yankton may safely be assumed to represent algal influences. Increased oxygen supply referable to air vents of flood control tunnels apparently was operative in early summer but only 85 percent saturation existed when the reservoir was stratified on July 20.

Above Fort Randall Reservoir oxygen supersaturation was a rare phenomenon, except below Garrison Dam were a prevailing supersaturated state was induced by air draft into the flood control tunnels. Supersaturation at other points was apparently a result of photosynthesis. Garrison Reservoir was below saturation until December 14, when plankton algae attained their first observed dense concentration.

Nitrogen

Nitrogen cycle compounds showed lower average concentrations in 1954 than in 1952-53 at all stations of record (Table 10, Appendix).

except Omaha where the ammonia average was slightly greater in 1954. Decline in nitrogen concentration may probably reflect its utilization by the greater quantities of life made possible by physical improvement of the environment. However, there is a possibility that this trend may be somewhat reversed by certain phases of biological activity as the now new reservoir and river conditions become more firmly established. It also seems unwise to ignore the possibility that greater quantities in 1952 and 1953 were related to the major flood in 1952, deposits from which could have remained on stream valley soils until removed by melting snow and rains the following year.

Organic Nitrogen

At all stations where records covered the entire year organic nitrogen concentration was very low the first six months. It increased to a rather high figure in July and, with few exceptions, continued in that range for the rest of the year (Table 11, Appendix). The maximum concentration (1.39 ppm.) was found at Pierre on October 12. Highs at other river stations were not far from that value, but maximums in and just below reservoirs fell noticeably below this mark. In 1953 Fort Randall Reservoir exhibited greater organic nitrogen density than did the river immediately below. The difference was not as great in 1954. At Garrison, the reservoir contained a slightly greater concentration than the river just below. In 1953 it was suspected that higher organic nitrogen content of reservoir surface water resulted from initial water contact with soils of the reservoir area. The Garrison picture in 1954 appears to lend support to this idea.

It is difficult at this time to ascribe reasons for organic

nitrogen lows and highs that occupied, respectively, the first and last six months of the year. They do not appear to be associated with other types of nitrogen compounds whose variation showed little relation to organic nitrogen or each other.

Other Nitrogen Compounds

Nitrite nitrogen occurred below Fort Randall Dam when the reservoir exhibited chemical stratification in July, but was absent at all other times and at all other regular stations (Table 11, Appendix). Ammonia ranged generally higher during the first six months but maximum concentrations were noted in September. Nitrate was absent in South Dakota reaches except during the very early and very late months of the year. In North Dakota the highest general level occurred above Garrison Reservoir, but the maximum concentration occurred at Mandan in November.

Phosphorous

Phosphorous in the available state (PO_4) was below the limit of analytical procedure (0.1 ppm.) in 1954. Total (unavailable) phosphorous varied considerably over the year, but in general showed higher ranges during the first six months (Table 12, Appendix). Highest concentrations occurred in Garrison Reservoir, and North Dakota stations were generally considerably higher in total phosphorous than any of the South Dakota sampling points, which exhibited a decline from 1952-53 levels.

Discussion of Chemistry

Reservoir influences upon chemical water quality were evident over longer river reaches in 1954. Activities promoted by impoundments generally tend to provide purification by removal of certain dissolved and suspended substances. Comparison of 1954 records with those of 1952-53 indicate a progressive reduction in hardness and alkalinity loads. Alkalinity and

hardness loads entering Fort Randall Reservoir were below those of the previous year, indicating modifications wrought by Garrison Reservoir. Garrison decreased hardness concentration in all reaches of the river between it and Fort Randall. To a large extent, reduction in hardness and alkalinity loads represents quantities retained in impounded water, but some loss by precipitation is also involved. Loss by this latter method may be expected to continue unless reservoir chemical stratification sets in and endures for long periods of time. In that event precipitation from surface layers will result in dissolved accumulations in deeper waters, and hardness and alkalinity loads and concentrations may be elevated in the river below each reservoir.

Photosynthetic induced oxygen supersaturation in and below Fort Randall Reservoir was characterisitic of only the first six months. In Garrison Reservoir, supersaturation was not noted until December. Below dams supersaturation was caused by air draft to flood control discharge tunnels. Oxygen excesses contributed in this manner soon left solution below Fort Randall Dam, whereas supersaturation due to algal action endured at least to Yankton.

The phosphorous and nitrogen pictures for 1954 show that in some respects a river's chemical nature changes with location of sampling points. Sampling was discontinued at the Bismarck water treatment plant in 1954. In 1952-53, water at Bismarck, by virtue of its phosphate and nitrite content, high nitrate values, reduced pH in warm water seasons, etc., indicated a higher level of organic decomposition than prevailed in the river in general. It was suspected that this condition represented purely local influences, and 1954 sampling at Mandan indicated more strongly that this was the case, as chemical features

there were more in line with usual river characteristics.

Biological Features

Plankton

Qualitative Features

The taxonomic grouping established for plankton analysis in 1952-53, with a few additions, was used in 1954. New forms attaining prominence in 1954 were Stichococcus sp. and a very small form tentatively placed in the Order Heterotrichales of the Class Xanthophyceae (Heterokontae). With few additions, plankton grouping was as shown in Table 7 of the first report.

Group predominance on a monthly basis at each station may be observed in Table 13 (Appendix) which shows the three most numerous groups in descending order. This table displays the importance of each reservoir to the plankton population in the river below it. Garrison and Fort Randall Reservoirs had generally dissimilar predominant plankters each month. Throughout the last six months the Garrison Reservoir plankton population largely dominated the river all the way down to the headwaters of Fort Randall Reservoir. Fort Randall Reservoir plankton types were generally predominant in the river as far as Omaha.

Groups attaining numerical superiority in 1952-53 were generally represented among the most numerous classes in 1954. However, Melosira (a), failing to develop more than a fraction of its 1953 population, never became the predominant form at any station; Asterionella enjoyed dominance over longer periods of time; and rank in the first three was at times attained by groups that were much less numerous or absent in 1952-53. Diatoma elongatum reached the number one spot during one month at all stations below Fort Randall, but never attained any position of prominence in or

below Garrison Reservoir. Asterionella became most abundant in Fort Randall in late winter and early spring, whereas its greatest development in Garrison came in late fall and early winter. In most respects qualitative differences between the two reservoirs involved abundance at different seasons of the generally predominant Missouri River groups and not greatly different annual populations. Specific differences may be noted by reference to Tables 13 and 14 (Appendix).

During most seasons numerical preponderance was held by one of the diatom groups. Green algae, Chlamydomonas gr., Gloeocystis, Stichococcus, etc., were most numerous upon few occasions, usually during periods of low total plankton density in cold water seasons. Bluegreen algae (Aphanizomenon) ranked with predominant groups in summer in North Dakota reaches, and upon one occasion were most numerous at Mandan. To date, however, the Missouri River plankton population has essentially consisted of alternations in dominance among a rather limited number of diatom groups. The reservoirs are largely instrumental in determination of plankton groups in the river below each, but to date have shown no seasonal agreement in populations. The Garrison type population survived down into the headwaters of Fort Randall Reservoir, and it is possible that greater similarity may characterize the two reservoir discharges in the future.

Displaced benthic forms did not attain the prominence they displayed in previous years. True plankters may possibly gain more dominance in succeeding years.

Quantitative Features

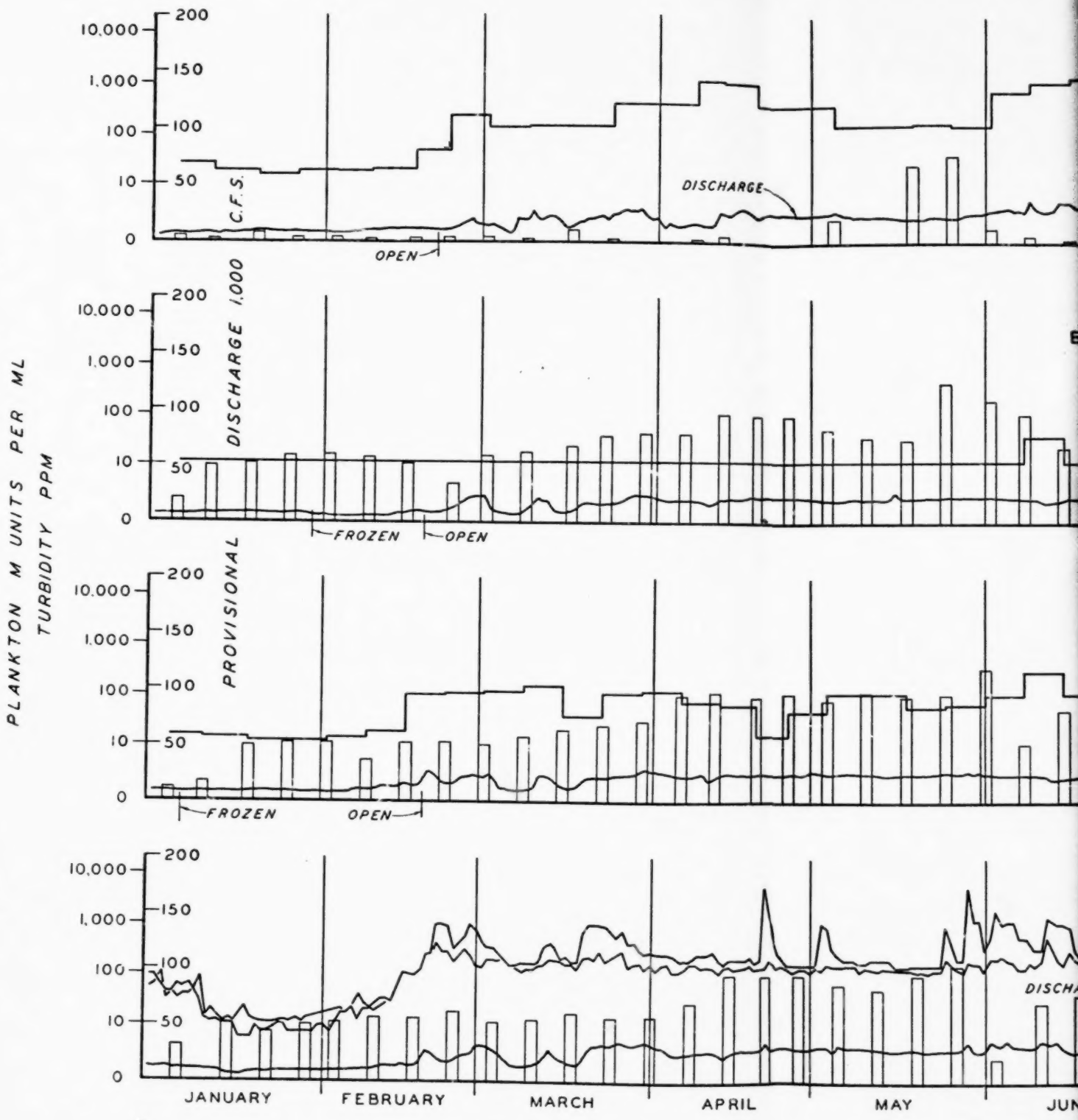
River Reaches Downstream from Fort Randall Reservoir

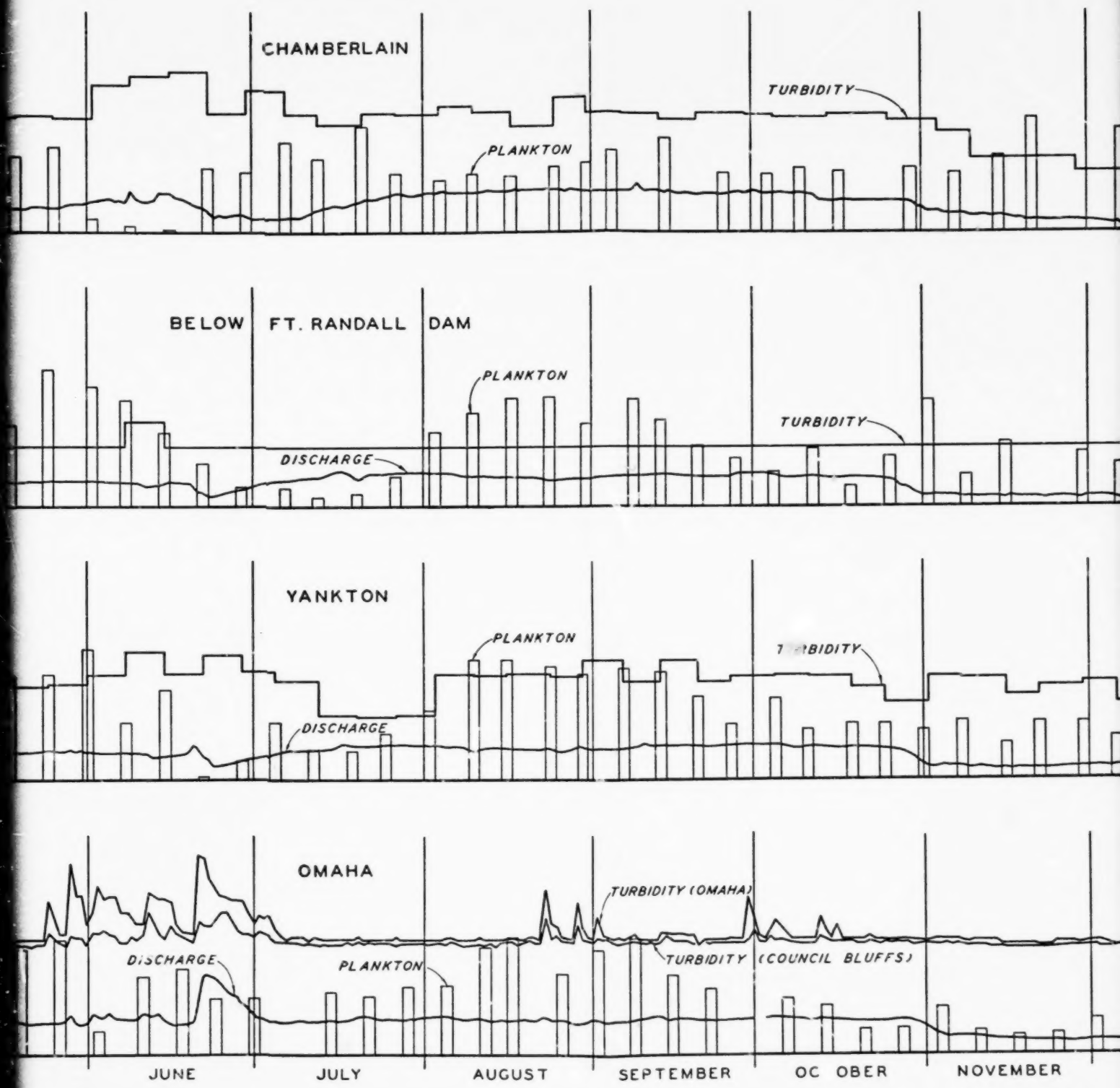
With river regimen considerably more subject to reservoir control,

the annual pattern of plankton density variation differed from that noted during any previous year (Figure 6). The severe decline of plankters that occurred in the early months of 1953 was not evident in 1954. Rather, there was a progressive increase in concentration, with only minor setbacks, from early January until June. This growth, primarily composed of Asterionella and Diatoma elongatum, was augmented by a sudden increase of Synedra in May, and appeared destined to influence water quality at Yankton (despite carbon and chlorine treatment). However, it suddently subsided during a period of extremely heavy local rains. Low level concentrations endured through most of July, but an increase to critical levels occured again in August and September. Late summer and early fall growth failed to attain the maximum concentration observed in 1953. However, as in 1953, the density exhibited a downstream increase from Fort Randall to Yankton. Plankton decline began again in late September, 1954, but late December levels were considerably above those of 1953. An elevation in concentration occurred at Fort Randall in early November.

Personnel limitations forced discontinuance of plankton analyses at Omaha during the critical period of growth in 1953. Analyses were resumed in October 1953 and continued at weekly intervals through December 1954. Records for 1954 show plankton features at Omaha to closely parallel events at Yankton and Fort Randall (Table 15). Average density at Omaha was 30 percent less and maximum concentration only slightly more than half of that attained at Yankton.

Average plankton concentration of Fort Randall Reservoir discharge was the same in 1953 and 1954. The average figure is not indicative of the amount of variation or generally prevailing levels. Greater uniformity and higher levels over most of the year marked 1954. There were


PLANKTON M UNITS PER ML
TURBIDITY PPM
DISCHARGE 1,000
C.F.S.
PROVISIONAL
10,000
1,000
100
10
0
200
150
100
50
DISCHARGE
OPEN
FROZEN
OPEN
FROZEN
OPEN
DISCHA
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUN

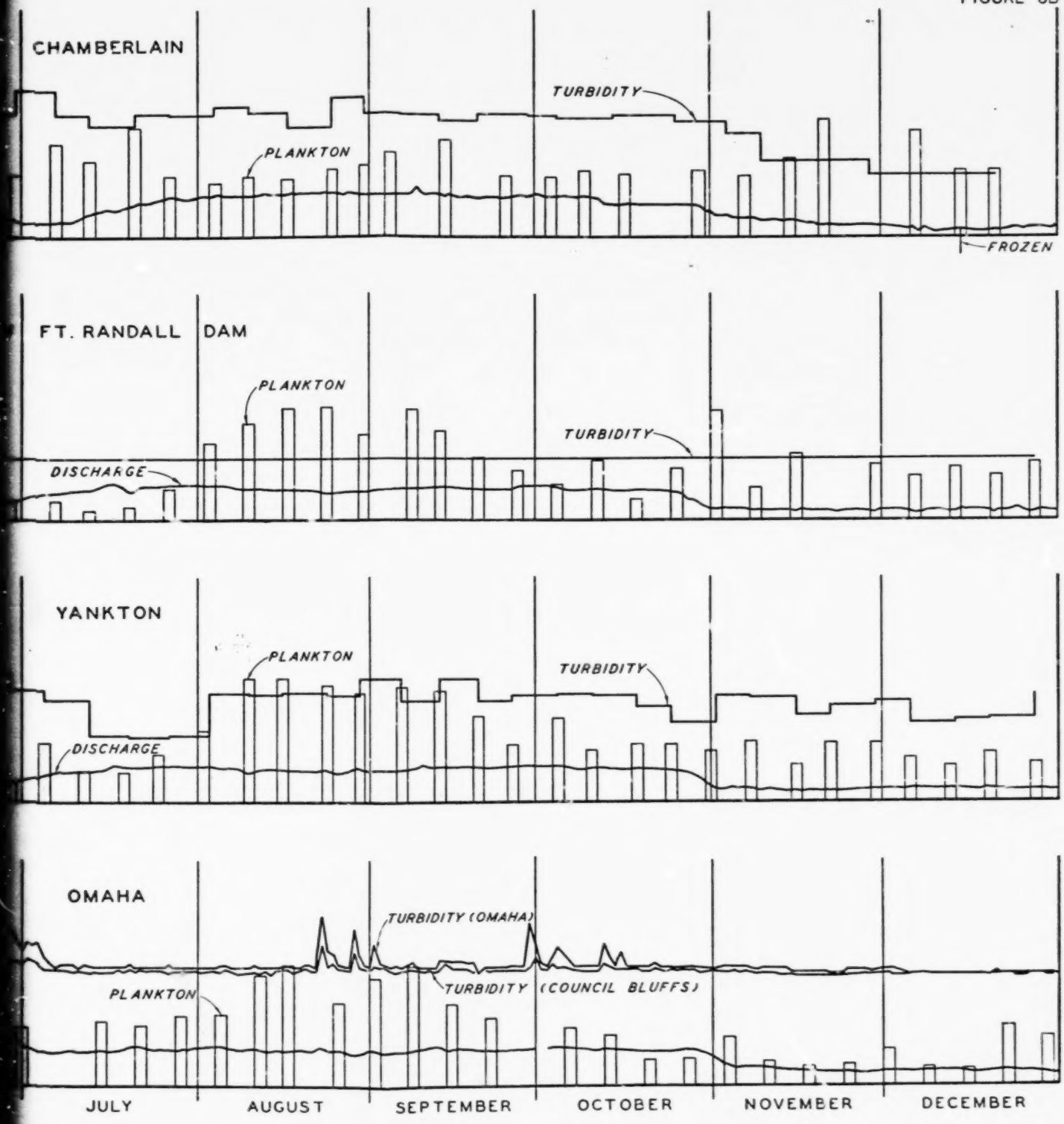


CENTRAL MISSOURI RIVER

PLANKTON DENSITY, DISCHARGE & T

JANUARY - DECEMBER 1954

FIGURE 68

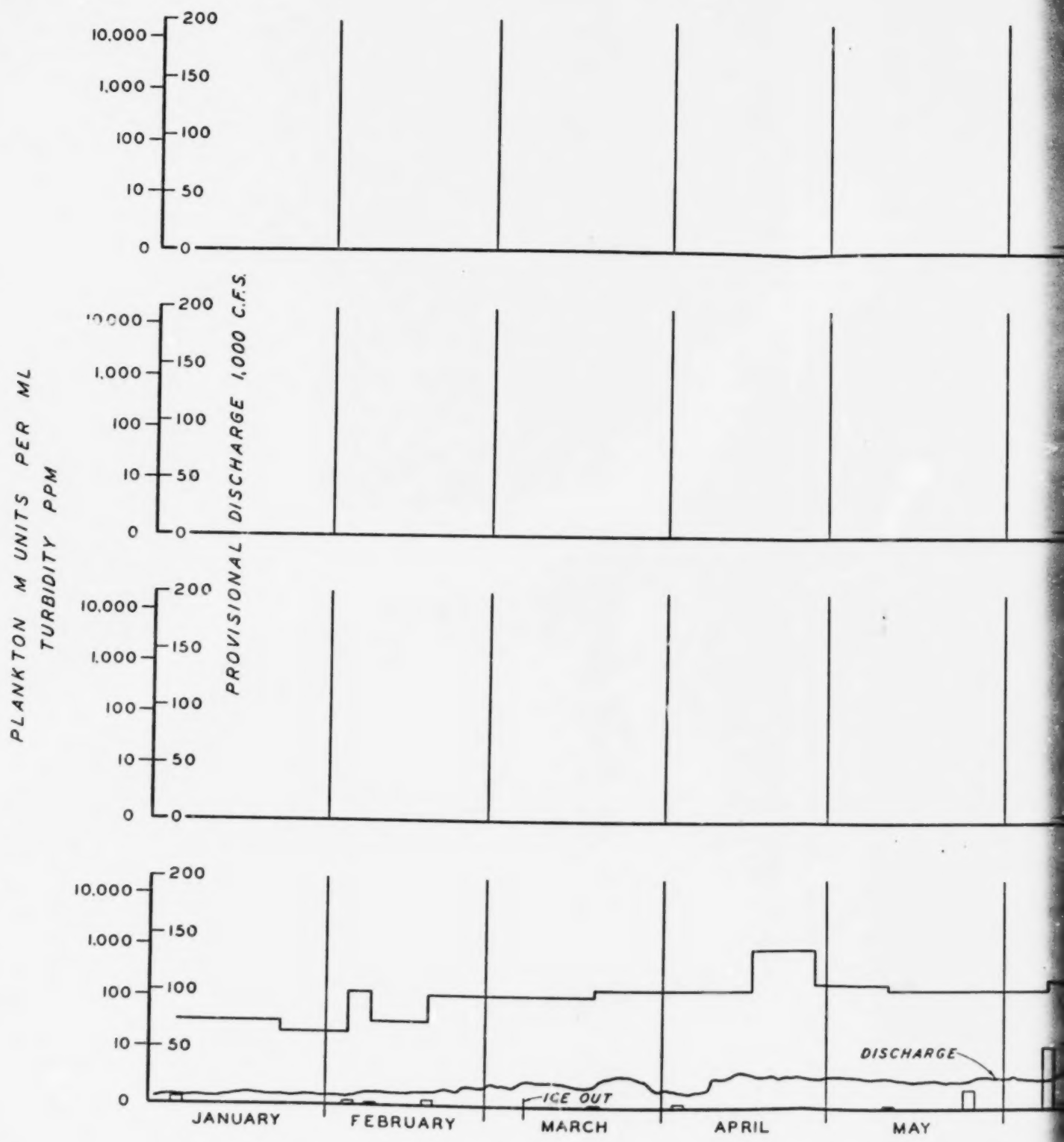


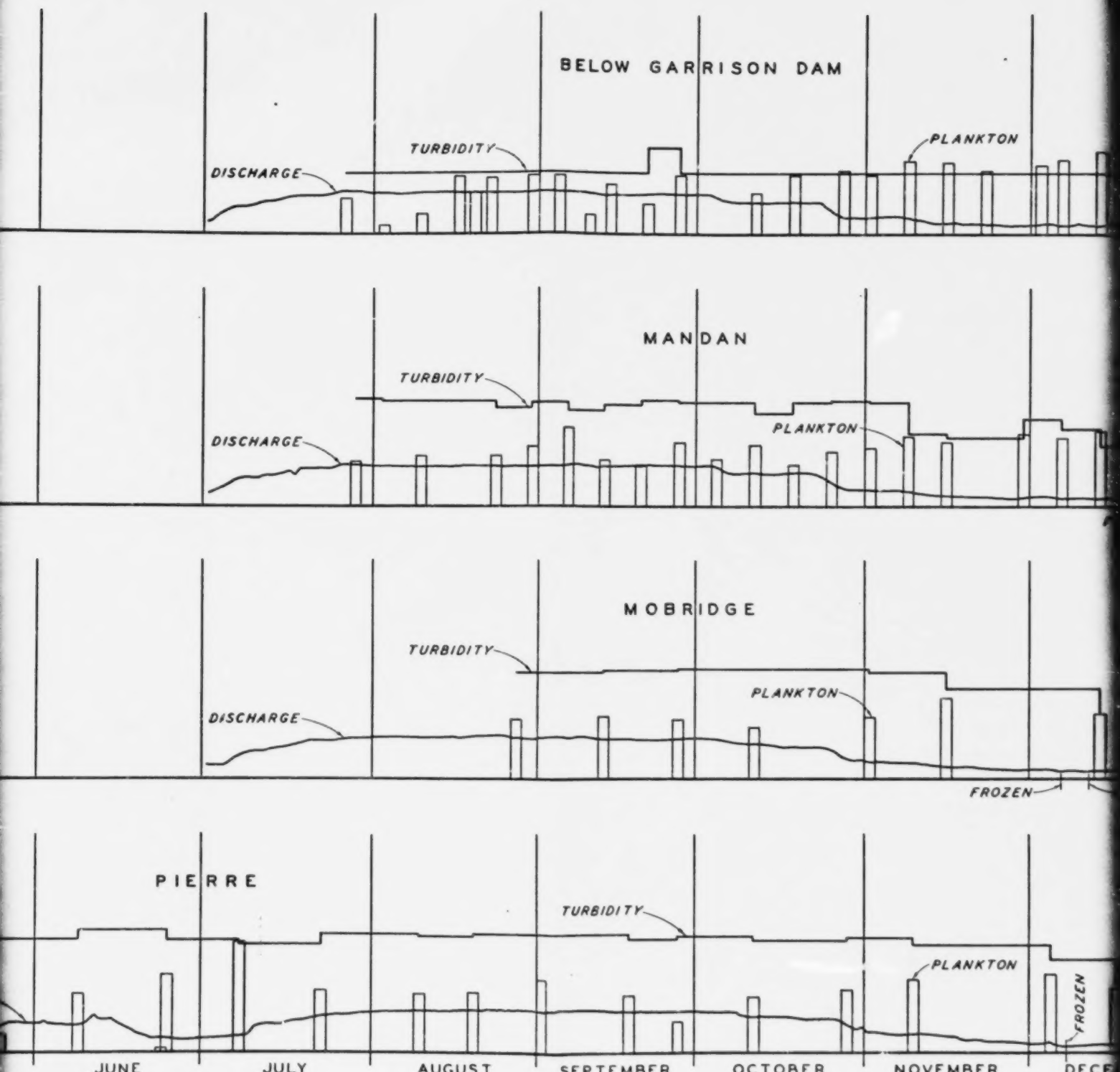
CENTRAL MISSOURI RIVER

PLANKTON DENSITY, DISCHARGE & TURBIDITY

JANUARY - DECEMBER 1954

34.4


PLANKTON M UNITS PER ML
TURBIDITY PPM
DISCHARGE 1,000 C.F.S.
PROVISIONAL
10,000
1,000
100
10
0
200
150
100
50
0
DISCHARGE
ICE OUT
JANUARY
FEBRUARY
MARCH
APRIL
MAY

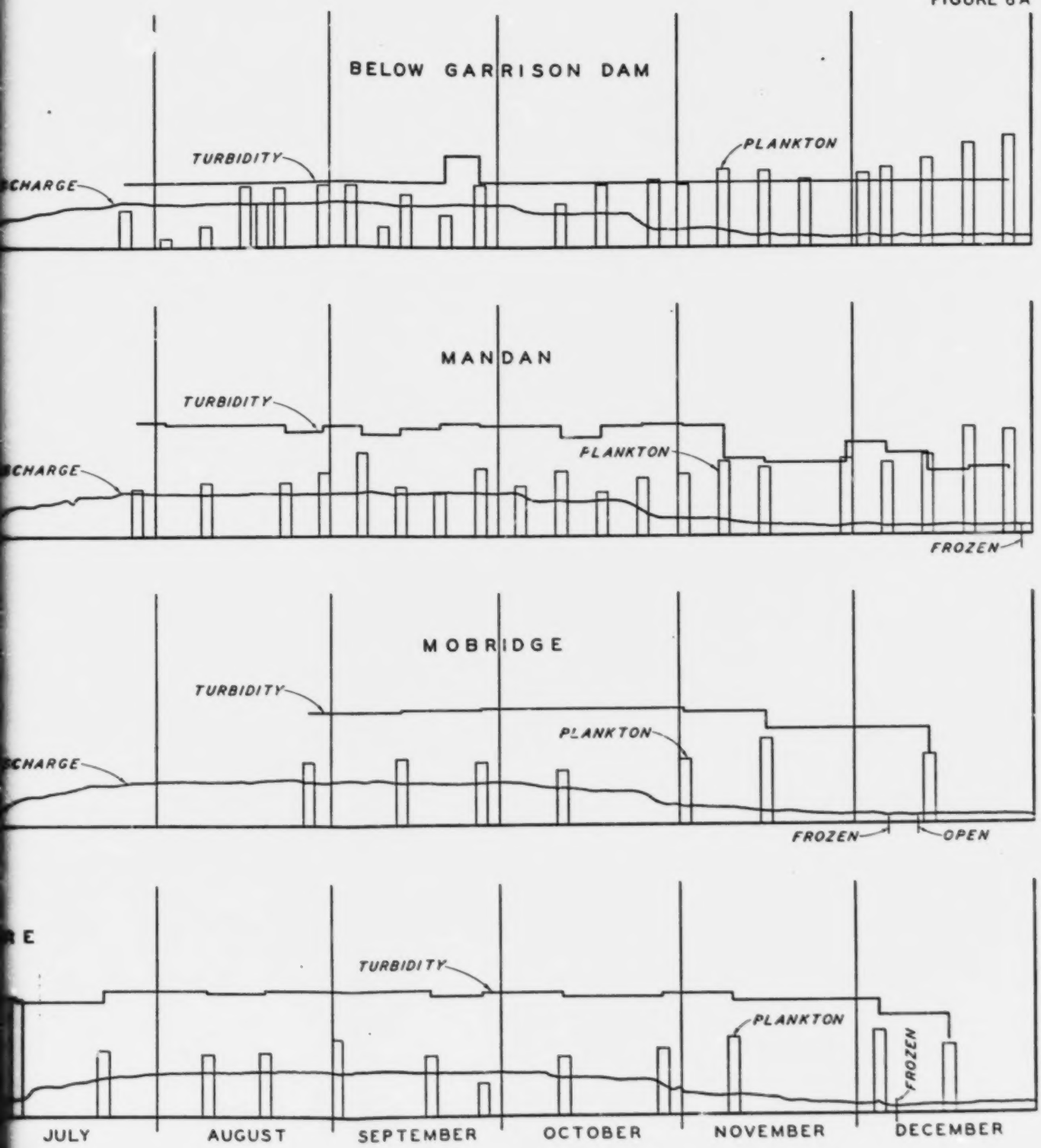


CENTRAL MISSOURI RIVER

PLANKTON DENSITY, DISCHARGE & TURB

JANUARY - DECEMBER 1954

FIGURE 6A



CENTRAL MISSOURI RIVER

PLANKTON DENSITY, DISCHARGE & TURBIDITY

JANUARY - DECEMBER 1954

34-B

two annual maxima, but neither developed as dense a concentration as was exhibited by the single bloom in 1953. Plankton levels were also more uniform at Yankton in 1954, but there the average density fell far below the 1953 figure. Averages and maximums (in M units per ml.*) for the two stations in 1953 and 1954 were as follows:

	Average		Maximum	
	1953	1954	1953	1954
Yankton	193.5	76	3037	600
Below Ft. Randall Dam	63	63	1014.5	693

Yankton levels showed less variation and densities in higher ranges persisted for longer periods than was the case in 1953.

River Reaches Downstream from Garrison Dam

Pierre and Chamberlain plankton densities benefited from the lower turbidities provided by Garrison Reservoir impoundment. Average concentrations at those two stations were approximately twice as great as in 1953. However, the maximum at Chamberlain was less than that developed in 1953. At Pierre the 1954 maximum was more than three times as great as that of 1953. 1954 averages were about the same at the two localities (Table 15). Fort Randall Reservoir rose to the overbank stage at Chamberlain in early November, and this event was probably of some significance in higher densities noted there in November and December.

* An M unit is a volumetric measure equivalent to a filament of Melosira (a) 600 microns long and 5 microns in diameter. M units per ml. may be converted to ppm. by volume by multiplying by 0.011175.

Table 15. Maximum and Average Plankton Concentrations (M units per ml.) at each station, 1954

	Maximum	Average
Omaha	326	54
Yankton	600	76
Below Fort Randall Dam	693	63
Fort Randall Reservoir	640	59
Chamberlain	120	26
Pierre	215	24
Mobridge (7 records)	58	27
Mandan (July-December)	97	29
Below Garrison Dam (Aug.-Dec.)	107	25
Garrison Reservoir (Aug.-Dec.)	118	28
Above Garrison Reservoir (Aug.-Dec.)	23	14

Garrison Reservoir failed to respond to the conditions of uniform discharge that have elicited the late summer and early fall plankton bloom in Fort Randall and below for the past two years. Maintaining this individualistic pattern, it developed its densest observed growth of the year in December when Fort Randall was near its annual minimum. Through December 31, plankton growths below Garrison did not attain a level troublesome to water treatment. In general the level at Mandan was very close to that of Garrison discharges. The average was somewhat greater but the maximum fell below that of the reservoir (Table 15). The November and December growth at Garrison apparently was responsible for increases all the way down to Chamberlain (then a part of Fort Randall Reservoir) as the same dominant form (Asterionella) was involved (Figure 6, Table 13, Appendix). The December decline at stations below Mandan appeared to be associated with the onset of ice cover.

Discussion of Biological Features

The 1954 plankton picture in and below Fort Randall Reservoir generally lived up to expectations. A dense growth developed in spring and early summer and was rapidly proceeding to a nuisance level when heavy local rains provided sufficient surface dilution to break it up. The late summer and early fall plankton maximum did not closely approach the greatest spring density or the high attained in 1953. However, periods of very low density were brief, and the general level was above that of 1953, although the average density was lower as a result of lesser maximum concentrations. Plankton development at Yankton and Omaha followed a path similar to that of the reservoir, except densities were slightly greater at Yankton and lower at Omaha. Dominant groups were usually the same at the three localities.

Increase in water level elevation did not proceed at the expected rate in Fort Randall Reservoir and upstream extension of the impoundment did not reach Chamberlain until early November. Plankton features at that locality generally followed Garrison Reservoir developments and were usually dissimilar to Fort Randall populations. The upper shallow regions of the reservoir are expected to produce algal densities that may impair the palability of public water supplies and impose difficulties upon water treatment at Chamberlain.

Fort Randall Reservoir

Considerable augmentation of storage volume occurred in 1954 (Figure 2). Maximum elevation (1343.0' above msl.), reached on November 30 was followed by a decline, and at the end of the year the water level was 1341.3' above msl.

Thermal and advanced chemical stratification were evident in the

area just above the dam in July. This condition resulted in a lower pH, lower oxygen, and slightly higher alkalinity, hardness, and total phosphorous values in discharged water (Tables 3, 9, 11, and 12, Appendix). Discharges then contained nitrite nitrogen. Stratification was of short duration and apparently disappeared before August 1. As in 1953, the reservoir surface waters contained more organic nitrogen than the discharges, but the difference was not as great. Ammonia nitrogen, which did not differ in 1953, had a mean concentration in surface waters that was twice that of the discharge in 1954. Nitrate nitrogen and total phosphorous also averaged slightly higher in the reservoir. Phosphorous was generally of the same range in surface and discharged waters, and its higher average in the reservoir was occasioned by a peak value attained on June 7. It appears that to date higher phosphorous and nitrogen values of surface water are referable to its initial contact with previously uninundated soils, and to the infrequency of stratification, which could be expected to build up nutrients in deeper layers.

A vertical series of samples collected September 21 at a point about one mile above the dam gave the results shown in Table 16. Maximum depth was 95 feet.

Table 16. Thermal and Chemical Features of a Vertical Series of Samples, Fort Randall Reservoir, September 21, 1954

Depth in feet	3	15	75	90
Temp. °C.	20	20	20	20
pH	8.3	8.3	8.3	8.2
CO_3 alk. ppm.	2	2	4	4
HCO_3 alk. ppm.	129	127	127	133
Oxygen % Sat.	87	87	87	87
PO_4 ppm.	0	0	0	0
NH_3 -N ppm.	0	0	0	0
NO_2 -N ppm.	0	0	0	0

The reservoir lacked thermal stratification on this date; and depth differences in chemistry were restricted to a slight increase in alkalinity near the bottom. Differences in alkalinity between 3 and 75' depths do not appear significant. The build-up near the bottom represented no unusual condition, and could have resulted from precipitation or bottom leaching. The slight decline in pH probably reflected the increase in bicarbonate alkalinity.

Plankton relationships between the reservoir surface and discharged water were reminiscent of those described for 1953 — the discharge having slightly greater maximum and average densities (Tables 14 and 15, Appendix).

Garrison Reservoir

Volume build-up differed seasonally from that at Fort Randall to the extent shown in Figure 2. Thermal or significant chemical stratification were not observed. Surface waters exhibited greater average concentrations of total phosphorous and organic nitrogen than did discharges. Ammonia and nitrate nitrogen averaged slightly greater in released water.

A vertical series of samples from the old channel just off the canal to the intake structure indicated no appreciable differences in surface and bottom layers. Results appear in Table 17. Maximum depth was 41 feet.

Table 17. Thermal and Chemical Features of Surface and Bottom Waters, Garrison Reservoir, September 15, 1954

Depth in feet	3	38
Temp. ^{o}C	15	14
pH	8.5	8.5
Oxygen % Sat.	85	82
PO_4 ppm.	0	0
NH_3 -N ppm.	0.25	0.2
NO_2 -N ppm.	0	0

Average and maximum plankton densities were slightly greater in surface layers of the reservoir than in its discharges (Table 15). In this respect as well as in seasonal qualitative and quantitative plankton variation this reservoir differed markedly from Fort Randall.

The Niobrara River

In previous years the Niobrara River afforded some alkalinity dilution in the Missouri; and its inflow was considered largely responsible for alkalinity decrease between Fort Randall and Yankton prior to dredging operations at Gavins Point. Results of 1954 analyses (Table 18) show general accord with previous records.

Table 18. Summary of Individual Physical and Chemical Analyses, Niobrara River

Date	9/20/54	10/18/54	11/8/54
Temperature °C.	22	-	10
Turbidity ppm.	240	430	250
pH	8.4	8.0	8.0
CO_3 alk. ppm.	16	0	0
HCO_3 alk. ppm.	111	132	124
Oxygen % Sat.	122	(10.4 ppm.)	102
NH_3 -N ppm.	0	0	0
NO_2 -N ppm.	0	0	0
PO_4 ppm.	0	0	0

The 1954 plankton (Table 19, Appendix) was very similar in composition to that noted in 1953, and was quite distinct from populations occurring in the Missouri River on or near the same dates.

Taste and Odor Occurrence

Despite the presence of higher prevailing plankton densities and the appearance of both spring and fall maxima, 1954 saw no taste and odor problems approaching the magnitude of those beginning at Yankton in late summer 1953.

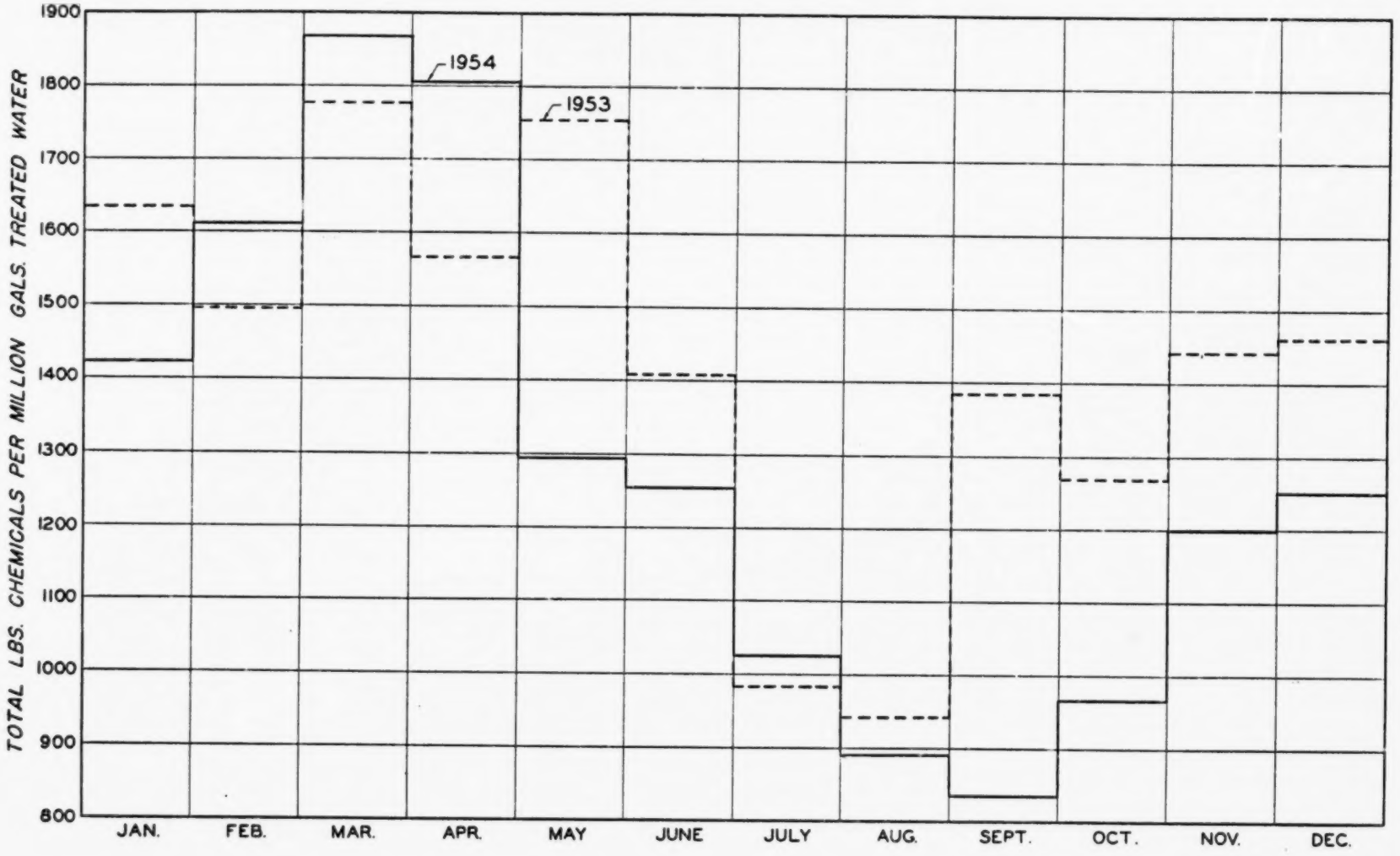
Troublesome periods at Yankton in 1954 were largely averted by advance notice of impending algal increases, which permitted water operators to institute appropriate treatment prior to the appearance of tastes and odors; and, also by heavy local rains that brought an abrupt end to the spring plankton bloom shortly after it entered the rapid proliferation or "log" growth phase. While human endeavor obviated nuisances of the more expected nature, it appears that nature prevented development of a situation, which, by all indications, would have been a difficult one to control by the usual methods.

Other water plants experienced little trouble. Operators at Mandan noted a slight unsavory flavor in December — probably a result of plankton upswing in and below Garrison Reservoir.

Reservoir Influences upon Water Treatment Costs

Water plant records concerning this aspect were made available at Yankton. Comparison of costs (based upon pounds of chemicals used per million gallons of treated water) for 1953 and 1954 is shown in Figure 7. Quantities of each chemical used appear in Table 20 (Appendix). As chlorine records for 1953 were not available, none are shown for 1954.

The first report showed a substantial savings in water treatment chemicals over the last six months in 1953 when reservoir influences were operative. In general, 1954 costs were considerably below those of 1953, particularly during summer and fall when reservoir releases largely determined the river discharge pattern. Lowered turbidity and hardness were the chief factors behind these savings, as they largely affected coagulants and chemicals used in softening. In the latter process the greatest savings were realized in chemicals used to reduce carbonate



CENTRAL MISSOURI RIVER

CHEMICALS USED - YANKTON, SO. DAKOTA

JAN. - DEC., 1953 AND 1954

FIGURE 7

hardness. Usage of activated carbon increased in the past two years, but accurate records are lacking. The cost of carbon was much less than the savings in other chemicals. Omaha operators reported lesser use of coagulants in 1954.

APPENDIX

Table 1. Temperature and Precipitation Departures from Normal

	Iowa		Nebraska		South Dakota		North Dakota		Wyoming		Montana	
	Temp. °F	Precip. (inches)	Temp. °F	Precip. (inches)	Temp. °F	Precip. (inches)	Temp. °F	Precip. (inches)	Temp. °F	Precip. (inches)	Temp. °F	Precip. (inches)
January	- 0.7	- 0.75	∤ 5.0	- 0.46	- 3.7	- 0.36	- 7.8	∤ 0.23	∤ 5.6	- 0.10	- 6.3	∤ 0.69
February	∤14.4	∤ 0.37	∤15.1	∤ 0.03	∤18.5	- 0.02	∤19.9	- 0.24	∤11.0	- 0.31	∤13.8	∤ 0.01
March	- 3.3	∤ 0.10	- 3.0	- 0.05	- 3.8	∤ 0.48	- 1.7	∤ 0.06	- 3.4	∤ 0.51	- 5.6	∤ 0.34
April	∤ 3.8	∤ 1.80	∤ 3.6	- 0.76	∤ 0.4	- 0.88	- 2.2	- 0.20	∤ 2.6	- 0.99	- 4.1	- 0.10
May	- 4.8	- 0.06	- 3.2	- 0.16	- 3.0	- 0.43	- 3.9	- 0.22	∤ 1.3	- 0.65	- 1.7	- 0.73
June	∤ 3.3	∤ 1.82	∤ 2.5	- 0.21	- 0.9	∤ 0.70	- 1.7	∤ 1.30	∤ 0.6	- 0.56	- 4.0	∤ 0.06
July	∤ 2.5	- 1.82	∤ 4.9	- 1.82	∤ 3.1	- 1.04	∤ 0.8	- 0.55	∤ 4.5	- 0.28	∤ 0.8	- 0.46
August	- 0.5	∤ 3.34	∤ 1.1	∤ 1.70	∤ 0.3	∤ 0.09	- 0.6	∤ 0.67	∤ 0.7	- 0.23	- 1.8	∤ 1.29
September	∤ 2.0	- 1.82	∤ 3.7	- 0.69	∤ 0.1	- 0.04	- 1.7	∤ 1.51	∤ 2.7	- 0.56	- 0.9	∤ 0.34
October	- 0.8	∤ 1.90	- 1.2	∤ 0.29	- 2.1	∤ 0.28	0.0	- 0.43	- 0.1	- 0.40	- 1.9	- 0.18
November	∤ 4.1	- 1.47	∤ 5.8	- 0.61	∤ 7.4	- 0.28	∤ 8.3	- 0.40	∤ 6.4	- 0.44	∤ 8.3	- 0.47
December	∤ 3.7	- 0.37	∤ 4.9	- 0.45	∤ 4.7	- 0.35	∤ 9.2	- 0.39	∤ 1.9	- 0.27	∤ 4.9	- 0.44
Annual	∤ 1.97	∤ 3.04	∤ 3.5	- 3.19	∤ 1.75	- 1.94	∤ 1.55	∤ 1.34	∤ 2.81	- 4.28	∤ 0.12	∤ 0.32

Table 3. Summary of Individual Temperature, pH, Alkalinity, and Hardness Measurements

Station	Date	Temp. °C	pH	CO_3 Alk. ppm.	HCO_3 Alk. ppm.	Total Alk. ppm.	Total Hardness ppm.
Yankton, S.D.	1/4/54						250
	1/17/54						276
	1/18/54	3.0	8.1	4.0	165.0	169.0	
	1/31/54						282
	2/15/54						272
	2/28/54						306
	3/9/54	4.0	8.3	8.0	191.0	199.0	
	3/15/54						316
	3/29/54						280
	4/11/54						260
	4/22/54	9.0	8.4	5.0	138.5	143.5	
	4/26/54						276
	5/5/54						268
	5/18/54	15.0	8.3	7.0	141.0	148.0	
	5/24/54						228
	6/7/54						202
	6/8/54	20.0	8.3	3.0	145.0	148.0	
	7/6/54						234
	7/7/54	25.0	8.3	6.0	141.0	147.0	
	7/18/54						230
	7/20/54	23.0	8.1	4.0	120.0	124.0	
	8/1/54						188
	8/15/54						172
	8/24/54	24.0	8.2	8.0	116.0	124.0	
	8/29/54						162
	9/7/54	24.0	8.4	4.0	114.0	118.0	
	9/12/54						166
	9/20/54	22.0	8.1	4.0	121.0	125.0	
	9/26/54						196
	10/4/54	12.0	8.1	3.0	137.0	140.0	
	10/16/54						224
	10/18/54	-	8.1	4.0	148.0	152.0	
	10/24/54						228
	10/29/54	9.0	8.1	4.0	146.0	150.0	
	11/7/54						232
	11/8/54	11.0	8.1	4.0	141.0	145.0	
	11/21/54						230
	11/22/54	8.0	8.1	2.0	138.0	140.0	
	12/5/54						240
	12/6/54	3.0	8.2	1.0	139.0	140.0	
	12/19/54						263
	12/20/54	3.0	8.2	4.0	146.0	150.0	
Below Ft. Randall Dam	1/18/54						276
	1/19/54	1.5	8.1	4.0	164.0	168.0	
	2/1/54						302
	2/15/54						316
	3/1/54						312
	3/9/54	2.5	8.2	2.0	193.0	195.0	
	3/16/54						326
	3/29/54						276
	4/12/54						262
	4/22/54	7.0	8.2	3.0	147.5	150.5	
	4/26/54						238
	5/16/54						244
	5/18/54	13.0	8.2	6.0	145.0	151.0	
	5/24/54						220
	6/7/54						200
	6/8/54	19.0	8.5	8.0	126.0	134.0	
	6/21/54						232
	7/6/54						236
	7/7/54	24.0	8.0	0.0	139.0	139.0	
	7/19/54						208
	7/20/54	25.0	7.8	0.0	128.0	128.0	
	8/2/54						188
	8/23/54						164
	8/24/54	24.0	8.2	4.0	105.0	109.0	
	8/30/54						156
	9/8/54	-	-	4.0	110.0	114.0	
	9/12/54	24.0	-	4.0	118.0	122.0	
	9/13/54						170
	9/21/54	20.0	-	4.0	125.0	129.0	
	9/27/54						206
	10/5/54	16.0	8.1	4.0	144.0	148.0	
	10/11/54						230
	10/19/54	13.3	8.2	5.0	146.0	151.0	
	10/25/54						232
	10/27/54	13.0	8.1	4.0	153.0	157.0	
	11/5/54	12.0	8.2	5.0	143.0	148.0	
	11/8/54						246
	11/19/54	9.0	8.2	4.0	148.0	152.0	
	11/29/54						242
	12/3/54	6.0	8.2	4.0	148.0	152.0	
	12/13/54						252
	12/16/54	4.5	8.2	4.0	145.0	149.0	
	12/27/54						252
	12/28/54	3.0	8.2	4.0	148.0	152.0	
Ft. Randall Reservoir	1/18/54						262
	2/1/54						274
	2/15/54						280
	3/1/54						312
	3/9/54	2.5	8.2	2.0	193.0	195.0	
	3/16/54						326
	3/29/54						284
	4/12/54						262
	4/22/54	7.0	8.2	3.0	147.5	150.5	
	4/26/54						236
	5/16/54						244
	5/18/54	13.0	8.3	6.0	142.0	148.0	
	5/24/54						220
	6/7/54						200
	6/21/54						232
	7/6/54						232
	7/7/54	26.0	8.2	4.0	135.0	139.0	
	7/19/54						208
	7/20/54	26.0	8.1	4.0	122.0	126.0	
	8/2/54						188
	8/23/54						164
	8/24/54	25.0	8.2	4.0	105.0	109.0	
	8/30/54						156
	9/8/54	-	-	4.0	110.0	114.0	
	9/12/54	23.0	-	4.0	112.0	116.0	
	9/13/54						168
	9/21/54	20.0	-	6.0	120.0	126.0	
	9/27/54						202
	10/5/54	16.0	8.1	4.0	144.0	148.0	
	10/11/54						224
	10/19/54	12.2	8.1	4.0	149.0	153.0	
	10/25/54						232
	10/27/54	13.0	8.1	4.0	151.0	155.0	
	11/5/54	12.0	8.2	5.0	143.0	148.0	
	11/8/54						236
	11/19/54	10.0	8.2	4.0	141.0	145.0	
	11/29/54						242
	12/3.54	5.0	8.2	4.0	146.0	150.0	
	12/13/54						244
	12/16/54	4.5	8.2	4.0	148.0	152.0	
	12/27/54						246
	12/28/54	3.0	8.2	4.0	148.0	152.0	

Station	Date	Temp. °C	pH	CO_3 Alk. ppm.	HCO_3 Alk. ppm.	Total Alk. ppm.	Total Hardness ppm.
Chamberlain, S.D.	1/11/54						346
	1/19/54	2.0	8.1	4.0	220.0	224.0	
	1/26/54						364
	2/8/54						368
	3/1/54						274
	3/9/54	2.5	8.1	2.0	154.0	156.0	
	3/16/54						246
	4/6/54						270
	4/12/54						262
	4/21/54	9.5	8.1	2.0	158.5	160.5	
	4/27/54						212
	5/11/54						190
	5/18/54	19.0	8.2	7.0	112.5	119.5	
	5/25/54						232
	6/8/54	20.0	8.2	1.0	139.5	140.5	
	6/22/54						186
	7/6/54						178
	7/8/54	26.0	8.3	6.0	120.0	126.0	
	7/20/54	27.0	8.3	6.0	115.0	121.0	174
	8/9/54						148
	8/26/54	25.0	8.2	4.0	115.0	119.0	
	8/30/54						216
	9/9/54	18.0	8.4	6.0	150.0	156.0	
	9/13/54						232
	9/16/54	18.0	8.3	4.0	140.0	144.0	
	9/29/54	15.0	8.1	5.0	149.0	154.0	
	10/4/54						238
	10/14/54	10.0	8.1	5.0	156.0	161.0	
	10/25/54	10.0	8.2	5.0	155.0	160.0	248
	11/9/54	7.5	8.1	4.0	153.0	157.0	258
	11/29/54	5.0	8.1	4.0	161.0	165.0	
	12/1/54						276
	12/7/54	1.0	8.2	6.0	160.0	166.0	
	12/14/54						288
	12/20/54						290
	12/21/54	1.5	8.1	4.0	178.0	182.0	
Pierre, S.D.	1/5/54						330
	1/23/54						350
	2/8/54						300
	2/18/54						262
	3/4/54						274
	3/19/54						214
	4/3/54						248
	4/15/54						214
	4/28/54						198
	5/11/54						182
	5/25/54						234
	6/8/54						186
	6/20/54						176
	7/7/54						166
	7/21/54						158
	8/13/54						150
	8/19/54						180
	9/1/54						218
	9/17/54						226
	9/27/54						238
	10/12/54						242
	10/28/54						242
	11/9/54						250
	12/4/54						276
	12/18/54						284
Robridge, S.D.	9/13/54	17.0	8.3	20.0	385.0	405.0	
	10/11/54	13.5	8.1	6.0	155.0	161.0	No data
	11/15/54	5.0	8.3	14.0	148.0	162.0	avail-
	12/13/54	0.0	8.4	1.0	165.0	166.0	able
Reliance, S.D.	7/26/54						128
	8/9/54						160
	8/22/54						210
	8/27/54	20.0	8.05	1.0	143.5	144.5	
	9/6/54						228
	9/13/54	15.0	8.3	12.0	127.0	139.0	
	9/28/54						208
	10/4/54						228
	10/13/54	-	8.1	10.0	143.0	153.0	
	10/18/54						224
	10/26/54						236
	11/3/54	4.0	8.2	8.0	157.0	165.0	-
	11/15/54						244
	11/17/54	5.0	8.2	8.0	151.0	159.0	
	11/29/54						252
	12/13/54						252
	12/15/54	3.0	8.2	12.0	154.0	166.0	
	12/27/54						254
Below Garrison Dam	7/26/54						128
	8/9/54						156
	8/22/54						212
	8/26/54	21.0	8.2	5.0	133.0	138.0	
	8/30/54						212
	9/10/54						218
	9/15/54	14.0	8.3	8.0	152.0	160.0	
	9/21/54						212
	9/27/54	14.0	8.1	10.0	154.0	164.0	
	10/4/54						228
	10/12/54	-	8.1	12.0	148.0	160.0	
	10/18/54						224
	11/2/54	4.5	8.2	14.0	153.0	167.0	236
	11/15/54						244
	11/16/54	5.0	8.2	10.0	148.0	158.0	
	12/2/54						250
	12/13/54						243
	12/14/54	1.0	8.2	12.0	149.0	161.0	
	12/27/54						252
Garrison Reservoir	7/26/54						128
	8/9/54						156
	8/22/54						212
	8/26/54	21.0	8.1	5.0	133.0	138.0	
	8/30/54						212
	9/10/54						218
	9/23/54						212
	9/28/54	14.0	8.1	8.0	155.0	163.0	
	10/4/54						230
	10/12/54	-	8.1	12.0	148.0	160.0	
	10/18/54						224
	11/2/54	4.5	8.2	12.0	154.0	166.0	240
	11/15/54						240
	11/16/54	5.0	8.2	12.0	142.0	154.0	
	12/2/54						252
	12/13/54						244
	12/14/54	0.0	8.2	10.0	150.0	160.0	
	12/27/54						252
Above Garrison Reservoir (Newtown or Sanish, N.D.)	8/26/54	18.5	8.2	4.0	137.0	141.0	
	9/14/54	13.0	8.4	8.0	191.0	199.0	220
	9/28/54	14.0	8.1	10.0	153.0	163.0	228
	10/12/54	13.0	8.1	8.0	151.0	159.0	224
	11/2/54	4.0	8.2	6.0	165.0	171.0	-
	11/16/54	5.0	8.2	10.0	155.0	165.0	240
	12/14/54	0.0	8.1	6.0	181.0	187.0	300

Table 141. Individual Plankton Analyses - Below Jarrison Dam

	7/26/54	8/2/54	8/9/54	8/16/54	8/19/54	8/22/54	8/30/54	9/6/54	9/30/54	9/14/54	9/21/54	9/27/54	10/11/54	10/18/54	10/27/54
PHYTOPLANKTON															
BLUE-GREEN ALGAE															
Coelosphaerium-Gomphosphaeria gr.			3	2	3	1									
Merismopedia				1											
Dactylococcopsis													2		
Oscillatoria gr.															3
Spirulina															
Aphanizomenon	13	7	7	4	23	11			1			1		1	2
YELLOW-GREEN ALGAE															
DIATOMS															
Melosira (a)			1	3		2	7		1	1		1			
Cyclotella-Stephanodiscus gr.					16	22	47	39	6	41	24	73	2	29	48
Cyclotella (a)		2		36			1					3			
Rhizosolenia gr.							2	14		2	5	31	4	25	11
Diatoma vulgare							1			1	18				7
Fragilaria crotonensis					1		1	2						1	
Fragilaria spp.															
Asterionella			2	2	4	10	23	10	4	3	2	11	21	27	53
Synedra gr.												2			
Gyrosigma gr.				1			1			1					
Navicula gr.								5		2	7	31		14	9
Gomphonema														1	
Nitzschia gr.				3	1			5			1	4	4	10	9
Surirella								2							2
EUGLENOPHYCEAE															
Heterotrichales sp.															
CHRYSOPHYCEAE															
Dinobryon sertularia													2	1	2
Kallomonas amdata													1		
GREEN ALGAE															
Chlamydomonas gr.						6		5	2		1	31	2	6	7
Sleocystis	1	1	1	3	10	4	18	22	9	39	30	4	3	21	15
Sphaerocystis								12							
Stichococcus				1	3			33		10	6	72		29	23
Pediastrum duplex				1		2				1					
Coelastrum sphaericum	1								1						
Coelastrum sp.				1	1	2	2	2		7	3	5		2	3
Dictyosphaerium								3	2			1		3	1
Chlorella								9		2					
Closteriopsis				1		1	1	4		1		1	1		
Ankistrodesmus					2		1	1		1	1	6		3	4
Franceia sp.							1			1					
Lagerheimia subsalsa															1
Lagerheimia wratislawensis														1	
Lagerheimia sp.								1							
Tetraedron												1			
Scherodesmus	6	2	3	4	3	4	1		2					1	1
Scenedesmus arcuatus					2										
Scenedesmus bijuga				3	4		6	6	1	3	1	1			
Scenedesmus dimorphus											1	2		1	
Scenedesmus quadricauda							2	4				1	1	2	1
Crucigenia fenestrata														1	
Crucigenia quadrata								6						6	8
Crucigenia rectangularis													1		
Crucigenia sp.							1			4					
Actinastrum								2		3	1			3	7
EUGLENOPHYTA															
Euglena acus									1						
Euglena spp.	28	1	3	33	1	13		2						4	1
Phacus sp.												2			
Trachelomonas spp.						1		4	1			2	3	4	2
YELLOW-BROWN ALGAE															
Ceratium		1		1											
ZOOPLANKTON															
PROTOZOA															
Diffugia urceolata															
Ciliata sp.				6		2									
ROTIFERA															
Polyarthra platyptera		1													
Philodina sp.													1		
Rotifera sp.			1			1									
CLADOCERA															
Bosmina sp.						1									
OSTRACODA															
Cypridopsis sp.															
TOTAL NO. PER ML.	51	13	28	120	75	83	117	195	31	163	91	292	48	208	222
TOTAL MG. CELLS PER ML.	6.3	1.5	7.3	13.9	7.4	12.0	17.4	18.0	3.4	8.3	5.4	19.8	7.4	19.3	23.7

Table 143.[9] Individual Plankton Analyses - Bailey Bayou Zoo (Cont'd.)

	11/3/54	11/9/54	11/15/54	11/21/54	11/27/54	12/3/54	12/13/54	12/20/54	12/27/54
PHYTOPLANKTON									
BLUE-GREEN ALGAE									
Coelosphaerium-Gomphosphaeria gr.									
Merismopedia									2
Dactylococcopsis									
Oscillatoria gr.		1				1			
Spirulina		1							
Aphanizomenon	1								
YELLOW-GREEN ALGAE									
DIATOMS									
Melosira (s)									
Cyclotella-Stephanodiscus gr.	58	26	22			3			
Cyclotella (s)	1	1	1				2		
Rhizosolenia gr.	9	1	1				1	2	3
Diatoma elongatum							2	1	2
Diatoma vulgare	1	2							
Fragilaria crotonensis					1				
Fragilaria spp.			32						
Asterionella	69	126	121	110	159	197	279	398	515
Synedra gr.	2	5	3	1	3				
Cymatopleura gr.		2							
Navicula gr.	13	3	2	1		5	2	1	3
Amphiprora							2		
Nitzschia gr.	5	2	3	3	5	2	3	3	3
Surirella				1	2	1	1		2
EUGLENOPHYCEAE									
Heterotrichales sp.								14	15
CHRYSOPHYCEAE									
Dinobryon cylindricum	2		1		1				
Ochromonas sp.								2	
GREEN ALGAE									
Chlamydomonas gr.		1	1	5		2	3	5	6
Gloeocystis	6	12	13				10	12	11
Kirchneriella		8					3		
Lithocosmum	13	7	8		1				
Microspora							4		
Pediastrum duplex									1
Scenedesmus spp.	2		2						1
Dictyosphaerium	1	2	1		1		2		
Chlorella		2	1					9	1
Closteriopsis	2	1							
Ankistrodesmus	3	3	4				3	3	3
Lagerheimia ciliata									
Lagerheimia wratislawiensis									1
Lagerheimia sp.									
Tetraedron							1		
Tetrastrum elegans							1		
Schroederia									
Scenedesmus armatus									1
Scenedesmus bijuga	4								
Scenedesmus dimorphus								1	2
Scenedesmus quadricauda		2		2				1	
Crucigenia fenestrata									
Crucigenia quadrata		8	4				16	15	13
Crucigenia rectangularis					1				
Crucigenia sp.	4								
Actinastrum	1	3	4		2	2	3	4	9
EUGLENOPHYTA									
Euglena acus									
Euglena spp.	4	6	11				18	37	7
Phacus sp.									
Trachelomonas spp.	2			4	1	5	2	4	4
YELLOW-GREEN ALGAE									
Carotin									
ZOOPLANKTERS									
PROTOZOA									
Difflugia urceolata								1	
Ciliata sp.									
ROTIFERA									
Polyarthra platyptera									
Philodina sp.									
Rotifera sp.									
CLADOCERA									
Bosmina sp.									
OSTRACODA									
Cetrudvia sp.									1
TOTAL NO. PER ML.	183	273	313	179	197	315	354	533	624
TOTAL "D" UNITS PER ML.	30.5	33.0	29.7	24.1	30.7	42.1	61.0	87.0	107.2

Table 1[illegible]. Individual Plankton Analyses - Bartlett Reservoir

SHEET 1

	7/26/54	8/2/54	8/9/54	8/16/54	8/19/54	8/27/54	8/30/54	9/6/54	9/10/54	9/14/54	9/21/54	9/27/54	10/11/54	10/18/54
PHYTOPLANKTON														
BLUE-GREEN ALGAE														
Chroococcus														8
Gomphosphaeria-Coelosphaerium gp.	1	1		1	8		1	5						1
Dactylococcopsis										1				
Oscillatoria gp.											1			
Spirulina													1	
Nostoc gp.	3				1									
Aphanizomenon	17	30	12	53	17	22	9	1			16	1		1
YELLOW-GREEN ALGAE														
DIATOMS														
Melosira (a)			1	2	1	2	3			2				
Cyclotella-Stephanodiscus gp.	1		4	14	27	14	20	16	8	14	6	135	28	17
Cyclotella (a)							1		2			4	1	
Stephanodiscus astraea							1				2			
Rhizosolenia gr.								3	2	3	1	23	24	2
Diatoma vulgare								6					2	
Fragilaria crotonensis						2		1					25	
Fragilaria spp.													23	
Asterionella			1	9	6	17	12	4	7	7	3	7		29
Synedra gp.				1			1			3				
Gomphonema					1									
Cymatopleura gp.													1	
Navicula gp.					1			1				28	3	
Cymbella				1										
Nitzschia gp.		1	2	1	2	1		5		2	3	3	3	7
Surirella				1	2									
GREEN ALGAE														
Oocystocystis ovata						3								
Staurastrum cristatum													1	2
Hallosphaera sp.													2	
GREEN ALGAE														
Chlamydomonas gp.	1			1	2		2	3		3	2	3	10	1
Pandorina morum			1											
Glocospyxis		1		1	3	2	2	7	10	3	2	7	27	
Sphaerocystis								1						
Staurastrum				3	3			1				30	28	1
Pediastrum boryanum				1										
Pediastrum duplex					1		2			1		1		
Scenedesmus abundans										1		1		
Scenedesmus ephaerium							1			2				
Scenedesmus sp.			1	2	1							7	2	
Closteriopsis			1	2	1			3		2	1	2		
Botryosphaerium						4	2		1			1		
Westella								1						
Chlorella													14	
Ankistrodesmus												4	9	
Botryococcus	2		2	13	3	3	2	2	3	2		1	1	
Selenastrum								1						
Tetraedron minimum										1				
Tetraedron sp.													2	
Tetrastrum staurogeniaeforme														1
Desmodesmus armatus					1									
Desmodesmus bijuga			4	10	3		2						3	
Desmodesmus dispar.s				1										
Crucigenia quadrata													1	
Crucigenia rectangularis								2						
Crucigenia sp.												2		
Actinastrum								2		2		2	1	
Gonearium									1					
EUGLENOPHYTA														
Euglena acus														1
Euglena sp.	3	3	21	34	11								2	
Phacus torta								1						
Phacus sp.												2		
Trachelomonas armeniaca														1
Trachelomonas sp.		2			4		2	4	2	2		1	4	2
YELLOW-BROWN ALGAE														
Ceratium		2	1			2								
PROTOZOANS														
PROTOZOA														
Difflugia globula							1							
Didinium		1		4	1									
Ciliate sp.			1	2	1									
CRUSTACEA														
Bosmina coregoni											1			
Bosmina sp.					1									
COPEPODA														
Cyclops sp.										1				
Nauplii						1								
TOTAL NO. PER ML.	27	47	53	190	107	86	75	66	36	53	36	290	268	70
TOTAL NO. UNITS PER ML.	5.1	6.7	6.9	26.9	12.6	10.9	10.8	8.3	3.9	6.6	7.1	38.6	34.8	11.1

Table 14A.[2] Individual Diatom Analyses - Bathurst Beaufort (Contd.)

	10/27/54	11/11/54	11/28/54	11/15/54	11/22/54	12/3/54	12/6/54	12/13/54	12/20/54	12/27/54
PHYTOPLANKTON										
BLUE-GREEN ALGAE										
Chroococcus	1									
Gomphosphaeria Coelosphaerium gr.					1					
Cyanarcus sp.							3			
Oscillatoria gr.	1		7	3						
Spirulina			1							
Aphanizomenon	1									
YELLOW-GREEN ALGAE										
DIATOMS										
Melosira (a)	1			1						
Cyclotella-Stephanodiscus gr.	11	64	119	16			7	14	9	3
Cyclotella (a)		1	11				3	6		
Rhizosolenia gr.	3	2	1	3			2	3	1	1
Diatoma elongatum					5				4	
Diatoma vulgare	2		7							
Fragilaria crotonensis	1	1								
Fragilaria sp.					9			10		
Asterionella	41	41	146	127	151	138	216	314	448	562
Synedra gr.		4		3					2	
Gyrosigma gr.										1
Navicula gr.	4	6	2	5						
Nitzschia gr.	14	5	1	1	8	2	2	3	1	3
Surirella			3	1	1	3	4		2	
EUGLENOPHYCEAE										
Heterotrichales sp.									15	14
CHRYSOPHYCEAE										
Dinobryon sertularia	2	1		3						
Mallomonas sp.			2					1	1	4
GREEN ALGAE										
Chlamydomonas gr.	4		1	5		2	6	5	5	5
Pandorina morum							6			1
Gloeocystis	1	9	8	11	3	2	12	4	19	15
Sphaerocystis			20						12	3
Elakatothrix	1						4			
Ankistrodesmus	1	10	8	9						
Microspora							2	8		
Scenedesmus sp.		3		1			1			
Closteriopsis		1		1			1			
Dictyosphaerium			1				3		1	1
Chlorella	1	3	4						12	12
Lagerheimia sp.										1
Ankistrodesmus	2	1	4	10			3	2	3	
Tetraedron elegans								1		2
Tetraedron minimum-incus-forme					1	1				
Scenedesmus bijuga	1		1						2	
Scenedesmus quadricauda			3	1				1	1	
Crucigenia quadrata			8	3			12	26	28	33
Crucigenia sp.		2								
Actinastrum		1	4	1	1		2	2	6	2
Characium							2			1
EUGLENOPHYTA										
Euglena sp.		2	37	4		1	23	47	7	21
Phacus tortus										
Phacus sp.										
Trachelomonas arcuata										
Trachelomonas sp.	3		3		2	1	3	3	3	3
YELLOW-BROWN ALGAE										
Ceratium										
ZOOPLANKTON										
PROTOZOA										
Difflugia globula										
Vorticella									2	2
Didinium										
Ciliata sp.										
ROTIFERA										
Polyarthra platyptera										2
Philodina sp.						1				
CLADOCERA										
Bosmina coregoni										
Bosmina sp.										
COPEPODA										
Cyclops sp.										
Nauplii										
TOTAL NO. PER ML.	96	159	423	234	182	171	321	494	548	674
TOTAL DRY WEIGHT PER ML.	10.7	16.7	34.9	32.0	16.6	33.1	49.0	71.6	94.6	118.9

Table 14m. Individual Plankton Analyses - Above Garrison Reservoir

	8/26/54	9/14/54	9/28/54	10/12/54	11/2/54	11/16/54	12/14/54
PHYTOPLANKTERS							
BLUE-GREEN ALGAE							
Oscillatoria gr.				2		1	
Aphanizomenon			1	1		1	
YELLOW-GREEN ALGAE							
DIATOMS							
Melosira (a)		1					
Cyclotella-Stephanodiscus gr.		11	13	6	10	7	8
Cyclotella (a)							20
Rhizosolenia gr.	4	4	14	7	1	8	10
Diatoma vulgare			2		5	5	
Fragilaria crotonensis		1	1	6	1	1	
Fragilaria spp.	4			2		7	
Asterionella		3	6	8	2	24	3
Synedra gr.				2	9	16	
Gyrosigma gr.	12	1	1	1	1		
Navicula gr.	4	33	42	3	28	21	1
Gomphonema			1		3		
Cymbella			1		2	2	
Nitzschia gr.			9	24	22	18	
Surirella							2
CHRYSOPHYCEAE							
Mallomonas sp.							1
GREEN ALGAE							
Chlamydomonas gr.				1			5
Gloeocystis			4			1	4
Stichococcus			3				
Microspora							3
Pediastrum duplex			1				
Closteriopsis			2	2			
Chlorella							9
Ankistrodesmus			3			1	32
Scenedesmus dimorphus		2	1	1			
Actinastrum			3				
EUGLENOPHYTA							
Euglena sp.						1	
Trachelomonas sp.				2			
TOTAL NO. PER ML.	24	56	108	68	84	114	98
TOTAL "M" UNITS PER ML.	10.6	5.5	13.9	23.1	18.6	21.7	1.7

Table 19. Individual Plankton Analyses - Niobrara River at Niobrara, Nebraska

	9/20/54	10/18/54	11/8/54
BLUE-GREEN ALGAE			
Oscillatoria gr.			2
DIATOMS			
Cyclotella-Stephanodiscus gr.	41	6	3
Rhizosolenia gr.	65		
Fragilaria spp.		96	31
Cocconeis		2	
Gyrosigma gr.		2	
Navicula gr.	18	41	34
Cymbella		2	1
Pinnularia		1	
Denticula			1
Rhopalodia	14	56	24
Nitzschia gr.	156	72	38
Surirella		1	
GREEN ALGAE			
Chlamydomonas gr.	624	4	
Oocystis	17		
Stichococcus		2	
Pediastrum duplex	17		
Dictyosphaerium	93	2	
Ankistrodesmus	130		
Scenedesmus dimorphus	91		
Scenedesmus quadricauda	123	1	1
Closteriopsis			1
Tetrastrum staurogeniaeforme	6		
Crucigenia rectangularis	26		
Actinastrum	21		
TOTAL NO. PER ML.	1,442	285	136

Table 20. Pounds of Chemicals used to Treat Gallons of Water, Yankton, S.D., 1953 and 1954

	Gallons Water into Plant		Alum		Lime		Soda Ash		Aluminate	
	1953	1954	1953	1954	1953	1954	1953	1954	1953	1954
January	30,262,000	32,077,000	0	0	35,124	28,923	10,306	11,977	4,000	4,240
February	27,644,000	27,347,000	0	3,675	30,703	25,764	6,670	10,526	4,000	3,740
March	32,127,000	34,422,000	9,010	8,000	32,043	35,797	13,010	15,788	3,015	4,310
April	30,801,000	33,209,000	6,685	6,015	29,830	37,239	9,167	11,984	2,385	4,335
May	33,175,000	42,177,000	9,290	3,812	35,079	36,204	10,912	9,271	2,850	4,823
June	45,512,000	48,024,000	11,330	10,185	41,165	36,291	7,669	8,490	3,950	4,838
July	55,759,000	67,976,000	9,320	6,900	42,105	46,799	1,210	10,829	2,211	4,418
August	47,228,000	47,917,000	6,880	2,000	36,036	36,788	0	722	1,630	2,656
September	37,918,000	38,432,000	6,115	1,100	34,030	28,396	9,967	0	2,400	2,148
October	40,004,000	34,162,000	1,660	0	37,516	26,879	8,058	3,441	3,540	2,055
November	33,514,000	33,401,000	3,190	0	33,775	28,067	6,789	7,188	4,650	4,251
December	32,970,000	33,140,000	2,830	0	31,674	30,316	9,799	6,579	3,988	4,040
Totals	446,914,000	472,284,000	66,510	41,687	419,080	397,463	93,443	96,795	38,619	45,854

Table 7. Alkalinity load entering, leaving, remaining in impounded water, and accumulated loss from solution in Ft. Randall Reservoir, 1953 and 1954, in pounds*

	(1)	(2)	(3)	(4)	(5)	(6)
	Inflow Load	Discharged Load	Load Retained in Theoretical Storage	Sum of Discharged and Retained Load	Inflow Load Minus Col. 4	Accumulation on Reservoir Floor
January 1953	360,706,944	353,837,484	17,953,012	371,790,496	- 11,083,552	
February	-	-	-	-	-	
March	821,793,077	850,693,846	8,900,091	859,593,937	- 37,800,860	- 48,884,412
April	574,327,050	538,188,462	24,819,748	563,008,210	11,318,840	- 37,565,372
May	945,429,120	890,055,306	72,652,140	962,707,446	- 17,278,326	- 54,843,898
June	1,393,219,620	1,485,794,700	64,889,532	1,550,684,232	-157,464,612	-212,308,510
July	843,036,624	700,993,944	53,001,000	753,994,944	89,041,680	-123,266,830
August	755,625,744	544,687,200	58,774,032	603,461,232	152,164,512	28,897,682
September	653,657,256	724,466,592	- 85,318,020	639,148,572	14,508,684	43,406,366
October	841,539,006	759,746,232	55,360,224	815,106,456	26,432,550	69,838,916
November	611,760,796	328,490,757	270,698,134	599,188,891	12,571,905	82,410,821
December	257,477,220	233,538,591	- 32,838,696	200,699,895	56,777,325	139,188,146
January 1954	319,557,728	230,339,424	10,883,684	241,223,108	78,334,620	217,522,766
February	-	-	-	-	-	-
March	495,241,344	537,960,150	73,190,304	611,150,454	-115,909,110	101,613,656
April	533,162,880	530,417,700	- 31,596,750	498,820,950	34,341,930	135,955,586
May	467,373,690	550,965,780	16,862,472	567,828,252	-100,454,562	35,501,024
June	541,860,480	287,487,396	118,208,538	405,695,934	136,164,546	171,665,570
July	468,651,150	607,092,480	-107,850,240	499,242,240	- 30,591,090	141,074,480
August	746,180,694	492,683,706	199,544,688	692,228,394	53,952,300	195,026,780
September	889,375,806	555,146,064	177,061,392	732,207,456	157,168,350	352,195,130
October	799,613,920	588,051,744	153,574,036	741,625,780	57,988,140	410,183,270
November	342,157,644	201,153,715	112,904,361	314,058,076	28,099,768	438,283,038
December	187,612,194	202,010,487	- 47,358,400	154,652,087	32,960,107	471,243,145

*Minus values reflect greater loads in discharge and usually loss of impounded water.

Table 6. Nerimess load entering, leaving, remaining in impounded water, and accumulated loss from solution in Ft. Randall Reservoir

		INFLOW				OUTFLOW				REMAINING IN RESERVOIR WATER				(13)	(14)	(15)
		Quantity Water		Nerimess		Quantity Water		Nerimess		Quantity Water		Nerimess				
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)			
Year	Month	Acre Foot	Pounds X 10^3	ppm.	Pounds	Acre Foot	Pounds X 10^3	ppm.	Pounds	Acre Foot	Pounds X 10^3	ppm.	Pounds	Sum of Discharged and Retained Loads	Column 4 Minus Column 13	Accumulation on Reservoir Floor
1953	January	691,200	1,878,681,600	308	578,634,056	657,500	1,787,045,000	320	571,867,000	33,700	91,596,600	312	28,761,958	600,626,658	- 21,992,602	- 21,992,602
	February	737,700	2,005,068,600	321	643,627,149	718,100	1,940,923,800	304	590,040,896	23,600	64,144,800	312	20,013,240	610,054,136	33,573,013	11,578,411
	March	1,747,700	4,750,246,600	295	1,401,323,455	1,729,200	4,699,965,600	286	1,344,190,276	18,500	50,283,000	290	14,582,070	1,358,772,346	42,551,109	54,129,520
	April	1,408,700	3,828,846,600	256	980,184,832	1,347,000	3,661,146,000	270	988,509,420	61,700	167,700,600	263	44,105,363	1,032,614,783	- 52,429,951	1,699,569
	May	2,174,000	5,908,932,000	268	1,583,593,776	2,009,000	5,460,462,000	256	1,397,878,272	165,000	448,470,000	242	117,499,140	1,515,377,412	68,216,364	69,915,933
	June	3,943,000	10,717,074,000	264	2,829,307,536	3,770,000	10,246,860,000	263	2,694,924,180	173,000	470,214,000	264	124,136,496	2,819,060,676	10,246,860	80,162,793
	July	2,264,000	6,153,552,000	164	1,009,182,528	2,114,000	5,745,852,000	155	890,607,060	150,000	407,700,000	160	65,232,000	955,839,060	53,343,468	133,506,261
	August	1,829,000	4,971,222,000	208	1,034,014,176	1,670,000	4,539,060,000	176	798,870,560	159,000	432,162,000	192	82,975,104	881,889,664	152,124,512	285,630,773
	September	1,636,000	4,446,648,000	236	1,049,408,928	1,851,000	5,031,018,000	230	1,157,134,140	- 215,000	- 584,370,000	233	-136,158,210	1,020,975,930	28,432,998	314,103,771
	October	2,010,500	5,464,539,000	236	1,289,631,204	1,876,000	5,098,968,000	234	1,193,156,512	134,000	364,212,000	235	85,589,820	1,278,746,332	10,882,872	324,986,643
	November	1,490,580	4,051,396,440	248	1,004,746,208	882,160	2,234,630,880	239	534,076,809	668,420	1,816,765,560	244	443,890,904	977,967,713	27,378,495	352,365,138
	December	526,280	1,430,429,040	302	431,989,558	600,860	1,633,137,480	248	405,017,976	- 74,580	- 202,708,440	275	- 55,728,700	349,273,276	82,716,282	435,081,420
1954	January	524,870	1,426,596,660	295	906,441,935	504,440	1,371,067,920	276	378,414,768	20,430	55,528,740	316	17,547,164	395,961,932	110,480,003	545,561,423
	February	640,550	1,741,016,900	308	536,832,620	611,330	1,661,594,940	309	513,432,895	29,220	79,419,960	308	24,461,360	537,894,215	- 1,661,595	543,899,828
	March	1,164,000	3,164,628,000	260	829,402,280	1,015,000	2,758,770,000	305	841,404,850	153,000	415,854,000	282	117,270,828	958,699,678	-133,293,398	410,606,390
	April	1,226,000	3,332,268,000	248	826,402,464	1,301,000	3,536,118,000	250	884,029,500	- 75,000	- 203,850,000	249	- 50,758,650	833,270,850	- 6,868,386	403,738,004
	May	1,445,000	3,927,510,000	211	828,704,610	1,398,000	3,799,764,000	232	881,945,248	47,000	127,746,000	228	28,359,612	909,904,860	- 81,200,250	322,537,754
	June	1,424,000	3,870,432,000	213	824,402,016	1,097,000	2,981,646,000	216	643,835,536	327,000	888,786,000	214	190,200,204	643,035,740	181,366,276	463,904,030
	July	1,425,000	3,873,150,000	176	681,674,400	1,745,000	4,742,910,000	223	1,057,668,930	- 320,000	- 869,760,000	200	-173,952,000	883,716,930	-202,042,530	261,861,500
	August	2,307,000	6,270,426,000	182	1,141,217,532	1,663,000	4,520,034,000	169	763,685,746	644,000	1,750,392,000	176	308,068,992	1,071,954,738	69,262,794	331,124,294
	September	2,167,400	5,889,906,000	232	1,366,458,192	1,668,400	4,547,984,000	188	862,540,992	479,000	1,301,922,000	210	273,403,620	1,135,944,612	230,513,580	561,637,874
	October	1,838,700	4,997,586,600	243	1,214,413,641	1,471,800	4,000,348,400	231	924,081,318	366,900	997,238,200	237	236,344,958	1,160,425,770	53,987,871	615,625,745
	November	781,900	2,125,208,800	258	548,328,638	510,400	1,387,267,200	244	338,493,148	271,500	737,937,000	251	185,222,187	523,715,335	24,587,297	640,213,04
	December	396,700	1,078,250,600	285	307,295,435	505,600	1,374,220,800	252	346,303,698	- 108,900	- 295,990,200	268	- 79,329,380	266,974,372	40,317,463	680,530,505

Table 9. Summary of Individual Oxygen Analyses % Saturation

Date	Yankton	Below Ft. Randall Dam	Ft. Randall Reservoir	Chamberlain	Mobridge	Mandan	Below Garrison Dam	Garrison Reservoir	Above Garrison Reservoir
1/19/54	122	122	-	97					
3/9/54	107	117	117	-					
4/21/54	-	-	-	95					
4/22/54	100	130	108	-					
5/18/54	106	142	142	107					
6/8/54	100	145	-	96					
7/7/54	100	134	102	-					
7/8/54	-	-	-	92					
7/20/54	90	85	102	98					
8/24/54	102	102	103	100					
8/26/54	-	-	-	-			128	99	90
9/7/54	98	-	-	-			-	-	-
9/9/54	-	-	-	105			-	-	-
9/10/54	-	118	77	-			-	-	-
9/13/54	-	-	-	-	86		-	-	-
9/14/54	-	-	-	-	-		-	-	80
9/15/54	-	-	-	-	-	92	114	-	-
9/16/54	-	-	-	97	-	-	-	-	-
9/20/54	95	-	-	-	-	-	-	-	-
9/21/54	-	137	92	-	-	-	-	-	-
9/28/54	-	-	-	-	-	-	114	90	90
9/29/54	-	-	-	90	-	-	-	-	-
10/4/54	77	-	-	-	-	-	-	-	-
10/5/54	-	126	75	-	-	-	-	-	-
10/11/54	-	-	-	-	96	-	-	-	-
10/12/54	-	-	-	-	-	-	-	-	88
10/14/54	-	-	-	81	-	-	-	-	-
10/19/54	-	120	78	-	-	-	-	-	-
10/25/54	-	-	-	89	-	-	-	-	-
10/27/54	-	126	79	-	-	-	-	-	-
10/29/54	93	-	-	-	-	-	-	-	-
11/2/54	-	-	-	-	-	-	124	90	90
11/3/54	-	-	-	-	-	90	-	-	-
11/5/54	-	95	100	-	-	-	-	-	-
11/8/54	98	-	-	-	-	-	-	-	-
11/9/54	-	-	-	82	-	-	-	-	-
11/15/54	-	-	-	-	99	-	-	-	-
11/16/54	-	-	-	-	-	-	119	92	86
11/17/54	-	-	-	-	-	92	-	-	-
11/19/54	-	95	97	-	-	-	-	-	-
11/22/54	91	-	-	-	-	-	-	-	-
11/29/54	-	-	-	91	-	-	-	-	-
12/3/54	-	87	85	-	-	-	-	-	-
12/6/54	92	-	-	-	-	-	-	-	-
12/7/54	-	-	-	82	-	-	-	-	-
12/13/54	-	-	-	-	97	-	-	-	-
12/14/54	-	-	-	-	-	-	120	106	87
12/15/54	-	-	-	-	-	95	-	-	-
12/16/54	-	90	90	-	-	-	-	-	-
12/20/54	92	-	-	-	-	-	-	-	-
12/21/54	-	-	-	95	-	-	-	-	-
12/28/54	-	86	87	-	-	-	-	-	-

Table 10. Average Phosphorous and Nitrogen Values (ppm) - 1952-1953 and 1954

	Total Phosphorous		Phosphate		Organic Nitrogen		Ammonia Nitrogen		Nitrite Nitrogen		Nitrate Nitrogen	
	1952 1953	1954	1952 1953	1954	1952 1953	1954	1952 1953	1954	1952 1953	1954	1952 1953	1954
Omaha	0.097	-	0.0	0.0	0.796	-	0.455	0.47	0.002	0.0	0.146	-
Yankton	0.063	0.037	0.0	0.0	0.752	0.408	0.398	0.105	0.0	0.0	0.11	0.034
Below Ft. Randall Dam	0.065	0.021	0.0	0.0	0.633	0.319	0.292	0.09	0.0	0.0005	0.109	0.006
Ft. Randall Reservoir	-	0.028	0.0	0.0	0.701	0.347	0.292	0.184	0.0	0.0	-	0.014
Chamberlain	0.061	0.020	0.0	0.0	1.01	0.383	0.353	0.10	0.0	0.0	0.085	0.054
Pierre	0.094	0.022	-	-	0.751	0.436	-	-	0.0	-	0.078	0.008
Mandan	-	0.258	-	0.0	-	0.591	-	0.10	-	0.0	-	0.161
Below Garrison Dam	-	0.137	-	0.0	-	0.559	-	0.10	-	0.0	-	0.103
Garrison Reservoir	-	0.180	-	0.0	-	0.576	-	0.08	-	0.0	-	0.100
Above Garrison Reservoir	-	0.307	-	0.0	-	0.717	-	0.057	-	0.0	-	0.182
Bismarck	-	-	0.11	-	-	-	0.228	-	0.016	-	1.58	-

Table 11. Summary of Individual Nitrogen Analyses

Station	Date	Organic Nitrogen	NH_3-Nitrogen	NO_2-Nitrogen	NO_3-Nitrogen
Omaha, Nebraska	9/15/54		0.35	0.00	
	9/22/54		0.35	0.00	
	9/29/54		0.15	0.00	
	10/6/54		0.45	0.00	
	10/13/54		0.35	0.00	
	10/20/54		0.35	0.00	
	10/27/54		0.54	0.00	
	11/3/54		0.55	0.00	
	11/10/54		0.75	0.00	
	11/17/54		0.60	0.00	
	11/24/54		0.30	0.00	
	12/1/54		0.55	0.00	
	12/8/54		0.45	0.00	
	12/15/54		0.55	0.00	
	12/22/54		0.45	0.00	
	12/29/54		0.45	0.00	
Tekamah, S.D.	1/4/54	0.07			0.00
	1/17/54	0.64			0.00
	1/19/54	-	0.15	0.00	-
	1/31/54	0.10	-	-	0.20
	2/15/54	0.15	-	-	0.20
	2/28/54	0.05	-	-	0.00
	3/9/54	-	0.25	0.00	-
	3/15/54	0.04	-	-	0.00
	3/29/54	0.02	-	-	0.20
	4/11/54	0.02	-	-	0.20
	4/22/54	-	0.20	0.00	-
	4/26/54	0.04	-	-	0.00
	5/9/54	0.06	-	-	0.00
	5/18/54	-	0.15	0.00	-
	5/24/54	0.00	-	-	0.00
	6/7/54	0.12	-	-	0.00
	6/8/54	-	0.05	0.00	-
	6/26/54	0.00	-	-	0.00
	7/4/54	-	-	-	0.00
	7/7/54	-	0.10	0.00	-
	7/18/54	0.60	-	-	0.00
	7/26/54	-	0.10	0.00	-
	8/1/54	0.43	-	-	0.00
	8/15/54	0.78	-	-	0.00
	8/24/54	-	<0.10	0.00	-
	8/29/54	0.88	-	-	0.00
	9/7/54	-	0.70	0.00	-
	9/12/54	0.59	-	-	0.00
	9/26/54	-	0.00	0.00	-
	9/26/54	0.69	-	-	0.00
	10/4/54	-	<0.10	0.00	-
	10/11/54	0.69	-	-	0.00
	10/18/54		<0.10	0.00	-
	10/24/54	0.83	-	-	0.00
	10/25/54	-	0.00	0.00	-
	11/7/54	1.29	-	-	0.00
	11/8/54	-	<0.10	0.00	-
	11/21/54	0.85	-	-	0.00
	11/22/54	-	<0.10	0.00	-
	12/5/54	0.49	-	-	0.40
	12/6/54	-	0.10	0.00	-
	12/19/54	0.92	-	-	0.50
	12/20/54		0.00	0.00	-
Below Ft. Randall Dam	1/18/54	0.07	-	-	0.00
	1/19/54	-	0.15	0.00	-
	2/1/54	0.05	-	-	0.00
	2/15/54	0.06	-	-	0.00
	3/1/54	0.07	-	-	0.00
	3/9/54	-	0.05	0.00	-
	3/16/54	0.04	-	-	0.00
	3/29/54	0.02	-	-	0.00
	4/12/54	0.02	-	-	0.00
	4/22/54	-	0.20	0.00	-
	4/26/54	0.05	-	-	0.00
	5/10/54	0.04	-	-	0.00
	5/18/54	-	0.05	0.00	-
	5/24/54	0.00	-	-	0.00
	6/7/54	0.07	-	-	0.00
	6/8/54	-	0.10	0.00	-
	6/21/54	0.00	-	-	0.00
	7/4/54	-	-	-	0.00
	7/7/54	-	0.15	0.00	-
	7/19/54	0.53	-	-	0.00
	7/26/54	-	0.10	0.01	-
	8/2/54	0.49	-	-	0.00
	8/23/54	0.58	-	-	0.00
	8/24/54	-	<0.10	0.00	-
	8/30/54	0.55	-	-	0.00
	9/8/54	-	0.40	0.00	-
	9/12/54	-	0.40	0.00	-
	9/13/54	0.60	-	-	0.00
	9/21/54	-	<0.10	0.00	-
	9/27/54	0.69	-	-	0.00
	10/5/54	-	0.00	0.00	-
	10/11/54	0.88	-	-	0.00
	10/19/54	-	0.00	0.00	-
	10/25/54	0.78	-	-	0.00
	10/27/54	-	<0.10	0.00	-
	11/5/54		<0.10	0.00	-
	11/8/54	0.00	-	-	0.00
	11/9/54	-	<0.10	0.00	-
	11/22/54	0.77	-	-	0.08
	12/16/54	-	<0.10	0.00	-
	12/27/54	0.77	-	-	0.07
	12/28/54	-	0.10	0.00	-
Ft. Randall Reservoir	1/18/54	0.07	-	-	0.00
	2/1/54	0.04	-	-	0.00
	2/15/54	0.05	-	-	0.00
	3/1/54	0.06	-	-	0.00
	3/9/54	-	0.05	0.00	-
	3/16/54	0.04	-	-	0.00
	3/29/54	0.02	-	-	0.00
	4/12/54	0.035	-	-	0.00
	4/22/54	-	0.20	0.00	-
	4/26/54	0.05	-	-	0.00
	5/11/54	0.05	-	-	0.00
	5/18/54	-	0.05	0.00	-
	5/24/54	0.00	-	-	0.00
	6/7/54	0.05	-	-	0.05
	6/21/54	0.00	-	-	0.00
	7/4/54	-	-	-	0.00
	7/7/54	-	0.10	0.00	-
	7/19/54	0.79	-	-	0.00
	7/20/54	-	0.10	0.00	-
	8/2/54	0.46	-	-	0.00
	8/23/54	0.67	-	-	0.00
	8/24/54	-	<0.10	0.00	-
	8/30/54	0.55	-	-	0.00
	9/8/54	-	2.00	0.00	-
	9 10/54	-	0.45	0.00	-
	9/13/54	0.66	-	-	0.00
	9/21/54	-	0.00	0.00	-
	9 27/54	0.59	-	-	0.00
	10/5/54	-	<0.10	0.00	-
	10/11 54	0.83	-	-	0.00
	10/19/54	-	<0.10	0.00	-
	10/25 54	0.87	-	-	0.00
	1 /27/54	-	<0.10	0.00	-
	11/5/54	-	0.10	-	-
	11 8/54	0.49	-	-	0.00

Station	Date	Organic Nitrogen	NH_3-Nitrogen	NO_2-Nitrogen	NO_3-Nitrogen
Ft. Randall Reservoir (Continued)	11/19/54	-	0.10	0.00	-
	11/29/54	0.87	-	-	0.00
	12/3/54	-	<0.10	0.00	-
	12/13/54	0.80	-	-	0.085
	12/14/54	-	<0.10	0.00	-
	12/27/54	0.72	-	-	0.075
	12/28/54	-	<0.10	0.00	-
Chamberlain, S.D.	1/11/54	0.085	-	-	0.000
	1/19/54	-	0.20	0.00	-
	1/26/54	0.090	-	-	0.300
	2/8/54	0.150	-	-	0.000
	3/1/54	0.070	-	-	0.000
	3/9/54	-	0.05	0.00	-
	3/16/54	0.040	-	-	0.000
	4/6/54	0.020	-	-	0.000
	4/12/54	0.020	-	-	0.000
	4/21/54	-	0.10	0.00	-
	4/27/54	0.040	-	-	0.000
	5/11/54	0.230	-	-	0.000
	5/18/54	-	0.05	0.00	-
	5/25/54	0.015	-	-	0.000
	6/8/54	0.150	0.10	0.00	0.900
	6/23/54	0.035	-	-	0.000
	7/6/54	-	-	-	0.000
	7/8/54	-	<0.05	0.00	-
	7/20/54	0.600	<0.05	0.00	0.000
	8/9/54	0.690	-	-	0.000
	8/24/54	-	<0.10	0.00	-
	8/30/54	0.790	-	-	0.000
	9/9/54	-	0.20	0.00	-
	9/13/54	0.780	-	-	0.000
	9/14/54	-	0.30	0.00	-
	9/21/54	-	<0.10	0.00	-
	10/4/54	1.240	-	-	0.000
	10/14/54	-	<0.10	0.00	-
	10/25/54	0.730	0.00	0.00	0.000
	11/3/54	0.815	<0.10	0.00	0.000
	11/29/54	-	<0.10	0.00	-
	12/1/54	0.730	-	-	0.000
	12/7/54	-	<0.10	0.00	-
	12/14/54	0.590	-	-	0.075
	12/20/54	0.750	-	-	0.013
	12/21/54	-	0.00	0.00	-
Pierre, S.D.	1/5/54	0.18	-	-	0.00
	1/21/54	0.10	-	-	0.00
	2/8/54	0.22	-	-	0.00
	2/18/54	0.15	-	-	0.00
	3/4/54	0.17	-	-	0.00
	3/19/54	0.09	-	-	0.00
	4/3/54	0.03	-	-	0.20
	4/15/54	0.02	-	-	0.00
	4/26/54	0.13	-	-	0.00
	5/11/54	0.04	-	-	0.00
	5/25/54	0.025	-	-	0.00
	6/8/54	0.07	-	-	0.00
	6/24/54	0.025	-	-	0.00
	7/7/54	-	-	-	0.00
	7/21/54	0.72	-	-	0.00
	8/11/54	0.43	-	-	0.00
	8/19/54	0.72	-	-	0.00
	9/1/54	0.72	-	-	0.00
	9/17/54	0.46	-	-	0.00
	9/27/54	0.85	-	-	0.00
	10/12/54	1.39	-	-	0.00
	10/28/54	1.02	-	-	0.00
	11/8/54	0.68	-	-	0.00
	12/1/54	0.68	-	-	0.00
	12/16/54	0.72	-	-	-
Reuben, S.D.	7/26/54	-	-	-	0.07
	8/9/54	0.70	-	-	0.09
	8/22/54	0.66	-	-	0.08
	8/27/54	-	<0.1	0.0	-
	9/4/54	0.78	-	-	0.09
	9/15/54	0.52	0.2	0.0	-
	9/20/54	-	-	-	0.16
	10/4/54	0.34	-	-	0.09
	10/13/54	-	0.1	0.0	-
	10/18/54	0.58	-	-	0.10
	10/24/54	0.38	-	-	0.08
	11/2/54	1.02	0.0	0.0	0.14
	11/15/54	0.56	-	-	0.10
	11/17/54	-	<0.1	0.0	-
	11/29/54	0.21	-	-	0.78
	12/13/54	0.42	-	-	0.12
	12/15/54	-	<0.1	0.0	-
	12/27/54	0.92	-	-	0.19
Below Garrison Dam	7/26/54	-	-	-	0.08
	8/9/54	0.60	-	-	0.09
	8/22/54	0.60	-	-	0.07
	8/26/54	-	<0.1	0.0	-
	8/30/54	0.55	-	-	0.16
	9/13/54	0.20	-	-	0.04
	9/15/54	-	0.2	0.0	-
	9/2/54	0.56	-	-	0.19
	9/28/54	-	<0.1	0.0	-
	10/4/54	0.28	-	-	0.08
	10/12/54	-	0.0	0.0	-
	10/18/54	0.34	-	-	0.07
	11/1/54	0.80	<0.1	0.0	0.16
	11/15/54	0.58	-	-	0.18
	11/16/54	-	<0.1	0.0	-
	11/29/54	0.84	-	-	0.10
	12/13/54	0.78	-	-	0.09
	12/14/54	-	<0.1	0.0	-
	12/27/54	0.78	-	-	0.09
Garrison Reservoir	7/26/54	-	-	-	0.08
	8/9/54	0.44	-	-	0.09
	8/24/54	0.61	-	-	0.08
	8/26/54	-	<0.1	0.0	-
	8/30/54	0.52	-	-	0.16
	9/10/54	0.26	-	-	0.03
	9/21/54	0.44	-	-	0.11
	9/28/54	-	<0.1	0.0	-
	10/4/54	0.30	-	-	0.08
	10/12/54	-	0.0	0.0	-
	10/18/54	0.36	-	-	0.07
	11/1/54	0.78	<0.1	0.0	0.12
	11/15/54	0.58	-	-	0.19
	11/16/54	-	<0.1	0.0	-
	12/1/54	0.77	-	-	0.10
	12/13/54	0.80	-	-	0.10
	12/14/54	-	<0.1	0.0	-
	12/27/54	0.82	-	-	0.09
Above Garrison Reservoir (Newtown or Beulah, N.D.)	8/26/54	-	<0.1	0.0	-
	9/1/54	0.36	0.1	0.0	0.15
	9/14/54	0.56	<0.1	0.0	0.17
	9/27/54	0.62	0.0	0.0	0.17
	10/1/54	1.32	0.1	0.0	0.14
	10/16/54	0.80	0.0	0.0	0.24
	10/14/54	0.66	0.0	0.0	0.22

Table 12. Summary of Total Phosphorous Analyses - ppm.

Date	Yankton	Below Ft. R wall Dam	Ft. Randall Reservoir	Pierre	Chamberlain	Mandan	Below Garrison Dam	Garrison Reservoir	Above Garrison Reservoir
1/4/54	0.100	-	-	-	-				
1/5/54	-	-	-	0.045	-				
1/11/54	-	-	-	-	0.027				
1/17/54	0.033	-	-	-	-				
1/18/54	-	0.010	0.027	-	-				
1/23/54	-	-	-	0.033	-				
1/26/54	-	-	-	-	0.010				
1/31/54	0.020	-	-	-	-				
2/1/54	-	0.000	0.010	-	-				
2/8/54	-	-	-	0.020	0.030				
2/15/54	0.040	0.040	0.040	-	-				
2/18/54	-	-	-	0.040	-				
2/22/54	0.020	-	-	-	-				
3/1/54	-	0.020	0.020	-	0.020				
3/4/54	-	-	-	0.025	-				
3/15/54	0.030	-	-	-	-				
3/16/54	-	0.050	0.025	-	0.025				
3/19/54	-	-	-	0.025	-				
3/29/54	0.035	0.035	0.035	-	-				
4/3/54	-	-	-	0.030	-				
4/6/54	-	-	-	-	0.020				
4/11/54	0.030	-	-	-	-				
4/12/54	-	0.040	0.020	-	0.025				
4/15/54	-	-	-	0.030	-				
4/26/54	0.015	0.013	0.010	-	-				
4/27/54	-	-	-	-	0.010				
4/28/54	-	-	-	0.010	-				
5/9/54	0.033	-	-	-	-				
5/10/54	-	0.033	0.030	-	-				
5/11/54	-	-	-	0.025	0.040				
5/24/54	0.320	0.045	0.250	-	-				
5/25/54	-	-	-	0.030	0.040				
6/7/54	0.020	0.015	0.020	-	-				
6/8/54	-	-	-	0.025	0.025				
6/21/54	-	0.020	0.020	-	-				
6/22/54	-	-	-	-	0.020				
6/24/54	-	-	-	0.030	-				
7/4/54	0.021	-	-	-	-				
7/6/54	-	0.015	0.012	-	0.010				
7/7/54	-	-	-	0.010	-				
7/18/54	0.021	-	-	-	-				
7/19/54	-	0.018	0.018	-	-				
7/20/54	-	-	-	-	0.020				
7/21/54	-	-	-	0.018	-				
8/1/54	0.015	-	-	-	-				
8/2/54	-	0.020	0.020	-	-				
8/9/54	-	-	-	-	0.015	0.310	0.320	0.260	-
8/11/54	-	-	-	0.015	-	-	-	-	-
8/15/54	0.015	-	-	-	-	-	-	-	-
8/19/54	-	-	-	0.010	-	-	-	-	-
8/22/54	-	-	-	-	-	0.130	0.130	0.140	-
8/23/54	-	0.015	0.015	-	-	-	-	-	-
8/29/54	0.020	-	-	-	-	-	-	-	-
8/30/54	-	0.020	0.020	-	0.015	-	0.200	0.210	-
9/1/54	-	-	-	0.015	-	-	-	-	-
9/9/54	-	-	-	-	-	0.270	-	-	-
9/10/54	-	-	-	-	-	-	0.010	0.030	-
9/12/54	0.025	-	-	-	-	-	-	-	-
9/13/54	-	0.015	0.015	-	0.025	-	-	-	-
9/14/54	-	-	-	-	-	-	-	-	0.120
9/17/54	-	-	-	0.020	-	-	-	-	-
9/21/54	-	-	-	-	-	-	0.220	0.220	-
9/26/54	0.005	-	-	-	-	-	-	-	-
9/27/54	-	0.010	0.010	0.010	-	-	-	-	-
9/28/54	-	-	-	-	-	0.400	-	-	0.500
10/4/54	-	-	-	-	0.012	0.280	0.290	0.770	-
10/10/54	0.017	-	-	-	-	-	-	-	-
10/11/54	-	-	0.017	-	-	-	-	-	-
10/12/54	-	-	-	0.012	-	-	-	-	0.740
10/18/54	-	-	-	-	-	0.750	0.100	0.140	-
10/24/54	0.015	-	-	-	-	-	-	-	-
10/25/54	-	0.015	0.012	-	0.012	-	-	-	-
10/26/54	-	-	-	-	-	0.250	-	-	-
10/28/54	-	-	-	0.012	-	-	-	-	-
11/2/54	-	-	-	-	-	-	0.050	0.050	0.200
11/3/54	-	-	-	-	-	0.220	-	-	-
11/7/54	0.022	-	-	-	-	-	-	-	-
11/8/54	-	0.020	0.015	-	-	-	-	-	-
11/9/54	-	-	-	0.027	0.025	-	-	-	-
11/15/54	-	-	-	-	-	0.160	0.035	0.045	-
11/16/54	-	-	-	-	-	-	-	-	0.230
11/21/54	0.015	-	-	-	-	-	-	-	-
11/29/54	-	0.015	0.010	-	-	0.180	-	-	-
12/1/54	-	-	-	-	0.010	-	-	-	-
12/2/54	-	-	-	-	-	-	0.170	0.170	-
12/4/54	-	-	-	0.020	-	-	-	-	-
12/5/54	0.017	-	-	-	-	-	-	-	-
12/13/54	-	0.015	0.015	-	-	0.190	0.110	0.120	-
12/14/54	-	-	-	-	0.015	-	-	-	0.050
12/16/54	-	-	-	0.010	-	-	-	-	-
12/19/54	0.020	-	-	-	-	-	-	-	-
12/20/54	-	-	-	-	0.010	-	-	-	-
12/21/54	-	0.010	0.012	-	-	0.007	0.008	0.008	-

Table 19. Most Numerous Organisms at Each Station in Descending Order for Each Month

Year 1954	Above Garrison Reservoir	Below Garrison Dam	Mandan	Pierre	Chamberlain	Below Ft. Randall Dam	Yankton	Omaha
January	-	-	-	Gloeocystis Chlamy. gr. Cyclo.-Stephano. gr.	Chlamy. gr. Cyclo.-Stephano. gr. Rhizosolenia	Chlamy. gr. Asterionella Heterotrichales	Asterionella Chlamy. gr.	Chlamy. gr. Cyclo.-Stephano. gr. Asterionella
February	-	-	-	Navicula gr. Chlamy. gr. Trachelomonas	Chlamy. gr. Cyclo.-Stephano. gr. Nitzschia gr.	Asterionella Heterotrichales Chlamy. gr.	Asterionella Diatoma elongatum Synedra gr.	Asterionella Nitzschia gr. Cyclo.-Stephano. gr.
March	-	-	-	Chlamy. gr. Trachelomonas	Chlamy. gr. Nitzschia gr. Cyclo.-Stephano. gr.	Asterionella Diatoma elongatum Synedra gr.	Asterionella Diatoma elongatum Synedra gr.	Asterionella Nitzschia gr. Synedra gr.
April	-	-	-	Cyclo.-Stephano. gr. Chlamy. gr.	-	Diatoma elongatum Synedra gr. Asterionella	Diatoma elongatum Synedra gr. Asterionella	Diatoma elongatum Asterionella Synedra gr.
May	-	-	-	Cyclo.-Stephano. gr. Surirella Trachelomonas	Asterionella Cyclo.-Stephano gr. Synedra gr.	Synedra gr. Asterionella Diatoma elongatum	Synedra gr. Asterionella Diatoma elongatum	Synedra gr. Asterionella Diatoma elongatum
June	-	-	-	Asterionella Cyclo.-Stephano. gr. Rhizosolenia	Asterionella Cyclo.-Stephano. gr. Oscillatoria gr.	Cyclo.-Stephano. gr. Synedra gr. Asterionella	Cyclo.-Stephano. gr. Synedra Asterionella	Cyclo.-Stephano. gr. Synedra gr. Asterionella
July	-	Euglena spp. Aphanizomenon Schroederia	Aphanizomenon Schroederia Nitzschia gr.	Asterionella Melosira (a) Cyclo.-Stephano. gr.	Asterionella Cyclo.-Stephano. gr. Melosira (a)	Cyclo.-Stephano. gr. Melosira (a) Nitzschia gr.	Cyclo.-Stephano. gr. Gloeocystis Cymbella	Cyclo.-Stephano. gr. Rhizosolenia gr. Navicula gr.
August	Cyrosigma gr. Navicula gr. Rhizosolenia gr.	Cyclo.-Stephano. gr. Euglena spp. Aphanizomenon	Asterionella Cyclo.-Stephano. gr. Aphanizomenon	Cyclo.-Stephano. gr. Asterionella Navicula gr.	Cyclo.-Stephano. gr. Asterionella Gloeocystis	Cyclo.-Stephano. gr. Melosira (a) Synedra gr.	Cyclo.-Stephano. gr. Melosira (a) Dictyosphaerium	Cyclo.-Stephano. gr. Melosira (a) Nitzschia gr.
September	Navicula gr. Cyclo.-Stephano. gr. Rhizosolenia gr.	Cyclo.-Stephano. gr. Stichococcus Gloeocystis	Cyclo.-Stephano. gr. Asterionella Stichococcus	Cyclo.-Stephano. gr. Asterionella Navicula gr.	Cyclo.-Stephano. gr. Asterionella Navicula gr.	Cyclo.-Stephano. gr. Melosira (a) Synedra gr.	Cyclo.-Stephano. gr. Melosira (a) Navicula gr.	Cyclo.-Stephano. gr. Melosira (a) Synedra gr.
October	Nitzschia gr. Asterionella Frag. crot.	Asterionella Cyclo.-Stephano. gr. Stichococcus	Stichococcus Asterionella Cyclo.-Stephano. gr.	Cyclo.- Stephano. gr. Asterionella Navicula gr.	Cyclo.-Stephano. gr. Asterionella Nitzschia gr.	Sphaerocystis Gloeocystis Cyclo.-Stephano. gr.	Navicula gr. Cyclo.-Stephano. gr. Stichococcus	Nitzschia gr. Cyclo.-Stephano. gr. Closteriopsis
November	Navicula gr. Nitzschia gr. Asterionella	Asterionella Cyclo.-Stephano. gr. Gloeocystis & Stichococcus	Asterionella Cyclo.-Stephano. gr. Navicula gr.	Asterionella Cyclo.-Stephano. gr. Gloeocystis & Navicula gr.	Asterionella Cyclo.-Stephano. gr. Chlamy. gr.	Nitzschia gr. Diatoma vulgare Crucigenia	Navicula gr. Crucigenia Rhizosolenia	Rhizosolenia Nitzschia gr. Fragilaria spp.
December	Ankistrodesmus Cyclotella (a) Rhizosolenia gr.	Asterionella Euglena spp. Crucigenia	Asterionella Chlamy. gr. Crucigenia	Asterionella Gloeocystis Euglena spp.	Asterionella Chlamy. gr. Gloeocystis	Rhizosolenia Cyclo.-Stephano. gr. Gloeocystis	Cyclo.-Stephano. gr. Navicula gr. Fragilaria spp.	Cyclo.-Stephano. gr. Nitzschia gr. Chlamy. gr.

Table 14a. Individual Plankton Analyses - Council R.Offs. Imp

	9/29/54	10/7/54	10/14/54	10/21/54	10/29/54	11/2/54	11/4/54	11/11/54	11/15/54	11/25/54	11/26/54	12/5/54	12/16/54	12/23/54	12/30/54
PHYTOPLANKTON															
BLUE-GREEN ALGAE															
Chroococcus										4					
Coelosphaerium-Gloeocapsa gr.							1								
Oscillatoria gr.		4		2			1								
Aphanizomenon		3													
YELLOW-GREEN ALGAE															
DIATOMS															
Melosira (a)		3	1		1		2				1				
Melosira (b)									1						
Cyclotella-Stephanodiscus gr.		6	16	14	16	56	11	4	15	14	28	21	20	27	70
Cyclotella (a)				2	3		2	5		15	37			11	17
Rhizosolenia gr.		4		2	2	7	7	11	17	32	28	1	1	2	1
Diatoma vulgare				2		1									1
Fragilaria spp.				9		1	4	6	3		3		3		4
Asterionella														1	1
Synedra gr.	4	2	9				4	6	6	2	1		1		
Gyrosigma gr.	12		1	2									1		
Navicula gr.	12	2	4	2	2	3		4	5	4	3			1	3
Cymbella							1								
Rhopalodia					2					2	3			2	1
Nitzschia gr.	31	8	14	4	9	3	1	19	2	13	19		2	3	
Surirella								1			1	1		2	
CRYPTOPHYTAE															
Hallimonas					2										
GREEN ALGAE															
Chlamydomonas gr.					2	4		4	2	2	3	4	3	1	3
Gloeocystis						2			2		1			2	2
Stichococcus									1		2				
Pediastrum duplex														2	
Coelastrum sphaericum									1						
Westella										2					
Chlorella													1		
Ankistrodesmus								1							
Closteriopsis		3	3	2	2			2							
Schroederia			1			1									
Tetrastrum staurogeniaeforme						2		1	3	2	5	1	3	5	1
Scenedesmus arcuatus							1								
Scenedesmus bijuga									2						
Scenedesmus dimorphus		2								2					
Scenedesmus quadricauda						1		3	2	2	1		1	2	
Crucigenia rectangularis									3	2					1
Actinastrum						2		2	1			1			
EUGLENOPHYTA															
Euglena sp.						1									
Trachelomonas sp.						3			1				1	9	
ZOOPLANKTON															
COPEPODA															
Nauplii															1
TOTAL NO. PER ML.	59	37	40	39	61	87	35	69	67	98	136	29	37	70	105
TOTAL "H" UNITS PER ML.	32.7	14.2	12.6	8.8	9.2	5.6	5.2	14.4	5.4	11.5	17.3	1.0	3.8	7.9	4.8

Table 149.[1] Individual Timatwa Analyses - Gauss, Empress

	1/6/54	1/13/54	1/20/54	1/27/54	2/3/54	2/10/54	2/17/54	2/24/54	3/3/54	3/10/54	3/17/54	3/24/54	3/31/54	4/7/54	4/14/54	4/21/54	4/28/54
PHYTOPLANKTON																	
BLUE-GREEN ALGAE																	
Oscillatoria gr.		1					1	1				1					
Spirulina																	
Nostoc gr.																	
Athanizomenon															2		
Merismopedia																	
Dactylococcopsis	2	1															
DIATOMS																	
Melosira (a)	2	1	1	2		3	5	5	2	2	2	4	2	2			
Melosira (b)																	
Cyclotella-Stephanodiscus gr.	6	66	89	27	6	7	6	6	6	3	2	10	9			60	
Stephanodiscus astraea																	7
Rhizosolenia gr.	1	3	1			4	2			1	8		2	2	2		
Tabellaria fenestrata							1										
Diatoma vulgare										1							
Diatoma elongatum											2		8	61	251	120	890
Synedra gr.			1		1	2	3	1			2		54	51	78	80	54
Fragilaria spp.			1					2	2	3	3	1	2	2			
Asterionella	11	11	17	46	86	105	75	10	9	59	133	41	83	124	177	60	125
Gyrosigma gr.															2	40	
Navicula gr.	1	3			1		3	10	8	6	7	2	3	2	4	40	10
Cymbella								2									
Amphiprora									1				2				
Rhopalodia	2							3	4	2		1			2		
Denticula												1		1			
Nitzschia gr.	1	8				1	6	45	15	13	6	12	4	8	6	40	10
Amphiprora																	
Cymatopleura solea								2					3				
Surirella								3	1		2	1	2	2		40	10
GREEN ALGAE																	
Chlamydomonas gr.	7	67	103	58	19	9		1	2	2	3						
Glenocystis	4	9															
Stichococcus																	
Pediastrum boryanum																	
Pediastrum duplex																	
Coelastrum sphaericum																	
Actinastrum						2	1				1						
Chlorella																	
Closteriopsis																	
Ankistrodesmus		1					2			2			2	2			
Schroederia																	
Dictyosphaerium																	
Tetrastrum staurogeniaeforme																	
Crucigenia bijuga																	
Scenedesmus dimorphus																	
Scenedesmus quadricauda																	
Scenedesmus sp.																	
Crucigenia rectangularis		2															
Crucigenia sp.		2															
Pleurotaenium																	
Cosmarium																	
EUGLENOPHYTA																	
Euglena acus																	
Euglena oxyuris																	
Euglena sp.		2		3		1											
Trachelomonas armaleta																	
Trachelomonas sp.																	
YELLOW-BROWN ALGAE																	
DINOPHYCEAE																	
Peridinium		1															
Ceratium																	
ZOOPLANKTON																	
PROTOZOA																	
Vorticella sp.																	
ROTIFERA																	
Trichocerca sp.																	
NEMATODA spp.																	
TOTAL NO. PER ML.	37	179	213	139	148	134	105	91	68	94	171	83	154	243	580	440	510
TOTAL MG WETH PER ML.	6.3	13.9	9.6	12.3	17.6	25.2	25.6	36.8	16.1	23.6	23.9	27.7	27.5	53.6	128.1	112.7	113.7

Table 149.[?] Individual Plankton Analyses - Sumbe, Benguela (Cont'd.)

	5/3/54	5/12/54	5/19/54	5/26/54	6/2/54	6/9/54	6/16/54	6/23/54	6/30/54	7/14/54	7/21/54	7/28/54	8/4/54	8/11/54	8/18/54	8/25/54	9/1/54
PHYTOPLANKTON																	
BLUE-GREEN ALGAE																	
Oscillatoria gr.							22		7		1						2
Lyngbya																	
Nostoc gr.																2	
Aphanizomenon	3	3	13					30	39		3						
Merismopedia																	
Anacystis-Coelosphaerium																	
DIATOMS																	
Melosira (a)	2	3									1	2	10	103	273	569	68
Melosira (b)	3										2	4	4	11	2	6	
Cyclotella-Stephanodiscus gr.	6	16	4	17	10	385	1883	23	13	31		188	72	364	913	148	46
Stephanodiscus astraea	5		44	27		38		10				2					
Thalassiosira gr.	19	3	27	20	20	10	6	5		33	12	18	12	11		1	2
Tabellaria fenestrata																	
Diatoma vulgare																	
Diatoma elongatum	203	117	57	293		20											
Synedra gr.	49	78	113	887		165	16		2	27	8	3	6	4		20	3
Fragilaria spp.		1				2	5		2			2				4	6
Asterionella	34	140	133	560	15	40	19	1									
Gyrosigma gr.																1	
Bacillaria gr.	3	4	10	7	3			3		36	16	16	16		3	16	16
Cymbella																	
Amphiprora																	
Rhopalodia																	7
Nitzschia																	
Nitzschia gr.	16	1	17	13		7	3	10		15	16	37	16	7	13	10	7
Amphiprora		1															
Grammatophora oceanica																	
Surirella	14	8	47	13					2		4					3	
GREEN ALGAE																	
Chlamydomonas gr.										6		2					
Gloeocystis	3									9	4	8				8	2
Pithophora																	
Pediastrum boryanum										2		2		3	2		2
Pediastrum duplex												4			2		8
Coelastrum sphaericum												2					
Actinastrum				27								2				8	
Chlorella										9	2						
Closterium gaia	3								4			2					2
Ankistrodesmus		1											2				
Schroederia											2						
Staurastrum											2					2	2
Scenedesmus bijuga										2	2					4	4
Scenedesmus dimorphus										2		4	4			2	
Scenedesmus quadricauda													8	8	6	4	7
Scenedesmus sp.										3							
Crucigenia rectangularis																	
Crucigenia sp.				3					2								
Pleurotaenium																	
Cosmarium																	
EUGLENOPHYTA																	
Euglena acus									2								
Euglena caputis																	2
Euglena sp.		1									4		2				
Trachelomonas armeniaca														3			
Trachelomonas sp.											2	2	2			1	
YELLOW-BROWN ALGAE																	
CHRYSOPHYTA																	
Peridinium																	
Ceratium																	
ZOOPLANKTON																	
PROTOZOA																	
Vorticella sp.											4						
ROTIFERA															8		
Trichocerca sp.										6							
CRUSTACEA N/P.																	
TOTAL NO. PER ML.	389	468	943	1,847	50	644	1,076	66	68	199	83	350	158	556	1,016	795	358
TOTAL MG. WET WT. PER ML.	86.5	77.4	91.7	290.8	4.3	53.0	70.0	14.6	15.2	24.3	17.2	33.0	35.6	178.0	326.0	20.0	148.0

Table App. 3 Individual Plankton Analyses - Otago Peninsula (Contd.)

	9/8/54	9/15/54	9/22/54	10/6/54	10/13/54	10/20/54	10/27/54	11/3/54	11/10/54	11/17/54	11/24/54	12/1/54	12/8/54	12/15/54	12/22/54	12/29/54
PHYTOFLAGELLATES																
BLUE-GREEN ALGAE																
Oscillatoria gp.						1	2			1		1				1
Anacystis				1	1											
Nostoc gp.																
Aphanizomenon			2	5	3	1										
Merismopedia																
Dactylococcopsis														1		
DIATOMS														1	2	
Melosira (a)	384	42	16	2	1			1								
Melosira (b)	11		2									1				
Cyclotella Stephanodiscus gp.	166	211	53	4	3	3	2	1		2	3	5	7	16	27	42
Stephanodiscus astraea																
Rhizosolenia gp.	2			1		3	1			2	26	10			4	1
Tabellaria fenestrata																
Diatoma vulgare								1			1	2		1	2	1
Diatoma elongatum																
Synedra gp.	24	54	27					2	3	1		2	1			
Fragilaria spp.	4	1		2			2	2			4	3	1	1		3
Asterionella													1			
Gyrosigma gp.	1	1	2					1		1						
Navicula gp.	3	1	7	1	1		4		1			1	1	3		1
Cymbella				1												
Amphiprora												1		1		
Amphiplaura	1							1		1		1		1	4	2
Pantocsekia																
Bacillaria gp.	7		4	7	9	6	3	4	4	1	3	6	4	1	14	3
Amphiprora																
Gyrosigma acuminatum																
Surirella												1		1	1	1
GREEN ALGAE																
Chlamydomonas gp.							2	1		1	1		4	2		3
Glenocystis	4		4					1		1	3			2	1	2
Gloeococcus							1				1					
Pediastrum Boryanum	3			1												
Pediastrum duplex	3							2	1							
Coelastrum sphaericum						1					1				1	
Actinastrum					1									1		
Chlorella															4	2
Closteriopsis	2		6	6	3	2	2	1			1					
Ankistrodesmus									1				1	1		2
Scherffelia																
Dictyosphaerium	11								1					2	2	1
Tetrastrum staurogeniaeforme																
Scenedesmus bijuga	3															
Scenedesmus dimorphus								1								
Scenedesmus quadricauda	2			1			1		1		1				1	
Scenedesmus sp.																
Crucigenia rectangularis										2	2					
Crucigenia sp.																
Pleurotaenium	1															
Cosmarium	1															
EUGLENOPHYTA																
Euglena acus																
Euglena viridis																
Euglena sp.	1															
Trachelomonas urceolata												1				
Trachelomonas sp.			2													2
YELLOW-BROWN ALGAE											3			2	3	
DINOPHYCEAE																
Peridinium																
Ceratium											1					
DIPLANETES																
PERIDINEA																
Peridinella sp.																
DINIFERA																
Ceratocorys sp.																
EBRIACEA Sp.							1									
TOTAL NO. PER ML.	562	399	183	31	27	17	19	19	12	13	51	33	20	47	60	77
TOTAL NO. CELLS PER ML.	329.1	55.0	50.1	12.1	9.1	6.6	6.9	8.6	4.3	5.3	9.0	6.5	3.1	9.3	15.1	9.0

Table 149. Individual Plankton Analyses - Summer, Pancake (Cont'd.)

	9/8/54	9/15/54	9/22/54	10/6/54	10/13/54	10/20/54	10/27/54	11/3/54	11/10/54	11/17/54	11/24/54	12/1/54	12/8/54	12/15/54	12/22/54	12/29/54
PHYTOFLAGELLATES																
BLUE-GREEN ALGAE																
Oscillatoria gr.						1	2			3		1				1
Lyngbya				1	1											
Nostoc gr.																
Aphanizomenon			2	3	3	1										
Merismopedia														1		
Dactylococcopsis														1	2	
DIATOMS																
Melosira (a)	284	41	16	2	1			1								
Melosira (b)	11		2									1				
Cyclotella-Stephanodiscus gr.	166	111	53	4	3	3	2	1		2	3	3	7	26	27	42
Stephanodiscus astraea																
Rhizosolenia gr.	2			1		3	1			2	26	10			4	1
Tabellaria fenestrata																
Diatoma vulgare								1			1	2		1	2	1
Diatoma elongatum																
Synedra gr.	24	14	17					2	3	1		2	1			
Fragilaria spp.	4	1		2			2	2			4	3	1	1		3
Asterionella													1			
Gyrosigma gr.	1	1	2					1		1						
Navicula gr.	3	1	7	1	1		2		1			1	1	3		1
Cymbella				1												
Gomphonema												3		1		
Hantzschia	1							1		1		1		1	4	2
Nitzschia																
Pinnularia gr.	7		4	7	2	4	3	4	4	1	3	4	4	1	14	3
Amphiprora																
Cymatopleura solea																
Surirella												1		1	1	1
GREEN ALGAE																
Chlamydomonas gr.							2	1		1	1		4	2		2
Glococystis	4		6					1		1	3			2	1	2
Stichococcus							1				1					
Pediastrum Boryanum	5			1												
Pediastrum duplex	5							2	1							
Coelastrum sphaericum						1					1				1	
Actinastrum					1									1		
Chlorella															4	2
Closteriopsis	2		6	6	3	2	2	1			1					
Ankistrodesmus									1				1	1		2
Schroederia																
Dictyosphaerium	13								1							
Tetrastrum staurogeniaeforme														2	2	1
Scenedesmus lijga	3															
Scenedesmus dimorphus								1								
Scenedesmus quadricauda	2			1			1		1		1				1	
Scenedesmus sp.																
Crucigeria rectangularis										2	2					
Crucigenia sp.																
Pleurotaenium	1															
Cosmarium	1															
EUGLENOPHYTA																
Euglena acus																
Euglena oxyuris																
Euglena sp.	1											1				
Trachelomonas armeulata																2
Trachelomonas sp.			2								3			2	3	
YELLOW-BROWN ALGAE																
DINOPHYCEAE																
Peridinium																
Ceratium											1					
ZOOFLAGELLATES																
PROTOZOA																
Vorticella sp.																
ROTIFERA																
Trichocerca sp.																
EMBRYOS ETC.							1									
TOTAL NO. PER ML.	542	369	125	31	27	17	19	19	12	13	51	33	20	47	68	77
TOTAL MM³ UNITS PER ML.	300.1	55.5	30.1	12.1	9.1	6.6	6.9	6.6	4.3	3.3	3.8	6.3	3.1	3.3	13.2	9.8

Table No. 3 Individual Plankton Analyses - Fountain, North Dakota

	3/9/56	3/15/56	3/18/56	3/25/56	4/1/56	4/8/56	4/15/56	4/22/56	4/29/56	5/1/56	5/7/56	5/15/56	5/22/56	5/29/56	6/5/56	6/12/56	6/19/56	6/26/56
PROTOPLANKTON																		
BLUE-GREEN ALGAE																		
Chroococcus																		
Gomphosphaeria-Coelosphaerium gr.																		
Merismopedia punctata																		
Snowiella-Anacystis																		
Oscillatoria gr.																		
Rivularia gr.																		
DIATOMS																		
Melosira (a)			9			1	6						1					
Melosira (b)							1											
Cyclotella-Stephanodiscus gr.			9			1	1				7		2	8	1			8
Cyclotella (a)																		
Rhizosolenia gr.											1	2	9	4	8	16	11	4
Chaetoceros																		
Diatoma elongatum			1	1			6	16	1	8	24	26	78	311	301	217	489	
Diatoma vulgare																		
Fragilaria spp.				3		1		6	6	3	1	6	2	4		1		
Asterionella	9	18	46	94	83	1	61	23	19	93	138	183	121	101	81	41	81	
Synedra gr.			1	2	4	1	3	3	2	4	23	39	89	111	186	60	88	
Rhoicosphenia																		
Cymatopleura gr.																		
Navicula gr.	1		1	1				11	12	4	1	8	4	6	6		4	
Cymbella								1		2					1			
Gomphonema gr.									2	1								
Pleurosigma strigile									3	3								
Rhopalodia								3	3	3		2	8		2			
Cymatopleura												1						
Denticula								1		1								
Rhizosolenia gr.	1							10	8	6		3	4	3		3	4	
Surirella								1	2			1	1	2	1			30
GREEN ALGAE																		
Calamydomonas gr.	4	5	11	15	4									1				
Pandorina morum																		
Gloeocystis																		
Sphaerocystis																		
Elakatothrix																		
Microspora																		
Oltheocoma																		
Stigeoclonium																		
Pediastrum duplex				1														
Pediastrum simplex																		
Pediastrum boryanum											2							
Pediastrum integrum																		
Coelastrum sphaericum																		
Coelastrum sp.																		
Chlorella																		
Dictyosphaerium																		
Closteriopsis											1							
Ankistrodesmus				1														
Scenedesmus																		1
Elakatothrix gelatinosa																		
Gonium sp.																		
Tetraedron																		
Scenedesmus acuminatus																		
Scenedesmus armatus																		
Scenedesmus bijuga																		
Scenedesmus dimorphus																		
Scenedesmus quadricauda																		
Crucigenia quadrata																		
Crucigenia rectangularis																		
Crucigenia sp.																		
Actinastrum																		
Tetraëdron planctonicum																		
Oocystis sp.																		
EUGLENOPHYTA																		
Euglena sp.																		
Phacus sp.																		
Trachelomonas sp.								1										
YELLOW-BROWN ALGAE																		
BACILLARIALES																		
Synedra sp.																		
Peridinium sp.																		2
DINOFLAGELLATES																		
PROTOZOA																		
Centropyxis aculeata							2	1										
Difflugia arcuiata																		
ROTIFERA																		
Polyarthra platyptera																		
Notifera sp.									1									
TOTAL NO. PER ML.	15	23	58	96	93	11	79	76	62	173	232	252	349	332	708	319	736	
TOTAL CMM PLANKTON PER ML.	2.3	3.4	10.3	16.8	17.1	7.3	14.6	17.9	12.3	28.3	70.3	48.4	33.8	132.9	362.1	68.6	151.6	

Table No. 3 Individual Plankton Analyses - Station, South Beach

	3/6/54	3/11/54	3/18/54	3/25/54	4/1/54	4/8/54	4/15/54	4/22/54	5/1/54	5/8/54	5/15/54	5/22/54	5/29/54	6/5/54	6/12/54	6/19/54	6/26/54
PHYTOPLANKTON																	
BLUE-GREEN ALGAE																	
Chroococcus																	
Gomphosphaeria-Coelosphaerium gr.																	
Merismopedia punctata																	
Anacystis cyanea																	
Oscillatoria gr.																	
Nostoc gr.																	
DIATOMS																	
Melosira (a)			2		1	6						1					
Melosira (b)						1											
Cyclotella-Stephanodiscus gr.			2		1	1			2		2	8	1				2
Cyclotella (a)																	
Rhizosolenia gr.									1	2	9	4	8	16	11		4
Chaetoceros																	
Diatoma elongatum			1	1			6	10	1	8	24	26	78	311	301	272	489
Diatoma vulgare																	
Fragilaria spp.				1		1		6	6	5	1	6	2	4		1	
Asterionella	9	18	40	9	83	1	61	23	19	83	158	143	123	101	81	42	81
Synedra gr.			1	2	4	1	3	3	2	2	83	27	69	111	188	60	88
Rhizosolenia																	
Cymatopleura gr.																	
Surirella gr.	1		1	1				11	12	4	1	8	4	6	1		4
Cymbella								1		2					1		
Gomphonema gr.									2	1							
Pinnularia viridis									3	3							
Rhopalodia								3	3	3		2	2		2		
Cymatopleura												1					
Bacillaria								1		1							
Nitzschia gr.	1							10	8	6		3	4	3		3	4
Surirella								1	2			1	1	2	1		32
GREEN ALGAE																	
Chlamydomonas gr.	4	3	13	15	4								1				
Pandorina morum																	
Gloeocystis																	
Sphaerocystis																	
Elakatothrix																	
Microspora																	
Bilimbassoa																	
Stigeoclonium																	
Pediastrum duplex				2													
Pediastrum simplex																	
Pediastrum boryanum										2							
Pediastrum integrum																	
Coelastrum sphaericum																	
Scenedesmus sp.																	
Chlorella																	
Ankistrodesmus																	
Closteriopsis										1							
Ankistrodesmus				1													2
Schroederia																	
Elakatothrix gelatinosa																	
Gonyaulax sp.																	
Tetraedron																	
Dictyosphaerium ehrenbergianum																	
Scenedesmus arcuatus																	
Scenedesmus bijuga																	
Scenedesmus dimorphus																	
Scenedesmus quadricauda																	
Crucigenia quadrata																	
Crucigenia rectangularis																	
Crucigenia sp.																	
Actinastrum																	
Tetraedron planctonicum																	
Cosmarium sp.																	
EUGLENOPHYTA																	
Euglena sp.																	
Phacus sp.																	
Trachelomonas sp.								1									
YELLOW-BROWN ALGAE																	
DINOPHYCEAE																	
Gymnodinium sp.																	2
Peridinium sp.																	
CHRYSOPHYTA																	
DIATOMEAE																	
Centropyxis aculeata							2	1									
Difflugia arcuata																	
EUGLENEA																	
Peloplastes platystoma																	
Entosiphon sp.									1								
TOTAL NO. PER ML.	15	23	58	96	93	11	77	74	62	123	312	232	278	556	709	379	716
TOTAL NO. PER 75X 75X ML.	0.3	0.4	10.3	16.8	16.1	2.3	13.6	12.9	11.3	18.3	54.2	40.4	73.6	102.0	142.1	66.4	125.5

Table 12a.[2] Individual Plankton Analyses - Inshore, Main Basin (Cont'd.)

	5/3/54	5/10/54	5/17/54	5/24/54	5/31/54	6/7/54	6/14/54	6/21/54	6/28/54	7/5/54	7/12/54	7/19/54	7/26/54	8/2/54	8/9/54	8/16/54	8/23/54	8/30/54
PHYTOPLANKTON																		
BLUE-GREEN ALGAE																		
Chroococcus										1								
Gomphosphaeria-Coelosphaerium gr.										2	1	2	2					
Merismopedia punctata																		
Anacystis cyanea											2			1				
Oscillatoria gr.									1									
Nostoc gr.															1			
DIATOMS																		
Melosira (a)		2			3		1		1	1				23	234	305	283	134
Melosira (b)		1	1		1					1	1				5	12	8	
Cyclotella-Stephanodiscus gr.	6	6	28	41	84	481	963	9	27	97	10	9	39	79	682	1,417	267	75
Cyclotella (a)																		
Rhizosolenia gr.	2	1							3	8	3	2	3	7	3	8	4	
Chaetoceros																		
Diatoma elongatum	213	150	82	81	213	194	80			1				1				
Diatoma vulgare																		
Fragilaria spp.					1					2					1	9		1
Asterionella	118	474	286	164	881	888	71			1								
Synedra gr.	81	215	154	373	1,679	468	46		1	3		1		5	3	4	16	16
Meloseiramia							2											
Gyrosigma gr.														2		2		
Navicula gr.	4	11	2		3	3	2		2	15	1	2	2	7	2	6	12	
Cymbella		1	2											2				
Amphora gr.	2							1										
Pleurosigma strigosum																		
Rhopalodia	1	2	2				1							2				
Cymatopleura															1			
Epithemia																		
Nitzschia gr.	10	3	3		11	6	16			15	2		2	13	1	6	4	6
Surirella	12	21	15	13	4				1					2				
GREEN ALGAE																		
Chlamydomonas gr.		1	6	13					7	13		2		1	1	2		
Pandorina morum						3	1						1					
Closterium									2		10	4	20	3	2	2		
Sphaerocystis		1															2	
Eudorina			1															
Micrasterias																		
Staurastrum																		
Oligocoleum										1								
Pediastrum duplex			3			3					1	3	3		4	3	3	
Pediastrum simplex																		
Pediastrum boryanum															2	4		
Pediastrum integrum																		
Coelastrum sphaericum							1									2		1
Coelastrum sp.													4		3			
Chlorella																		
Dictyosphaerium									4					3	36	88	303	
Closteriopsis							1						1			2		
Ankistrodesmus					1		2				2		7			2	4	
Schroederia											1		1					
Elakatothrix gelatinosa													1					
Oocystis sp.															2			
Tetraedron																		
Scenedesmus acuminatus																		
Scenedesmus arcuatus											2		8	1				
Scenedesmus bijuga							1								1			
Scenedesmus dimorphus				3						3			16	1	1			
Scenedesmus quadricauda			1	3	3	3				2	1	1	1	1	2	2	2	
Crucigenia quadrata																		
Crucigenia rectangularis																		
Crucigenia sp.															4			
Actinastrum		1	1							1		1						
Tetraedron staurogeniaeforme																		
Gymnozyga sp.																		
EUGLENOPHYTA																		
Euglena sp.																		
Phacus sp.																		
Trachelomonas sp.	2			3	1			1				6				2		
YELLOW-BROWN ALGAE																		
DINOPHYCEAE																		
Gymnodinium sp.																		
Peridinium sp.			1															
SCHIZOMYCETES																		
PROTOZOA																		
Centropyxis aculeata				3														
Difflugia arcuelata		1	1															
ROTIFERA																		
Polyarthra platyptera					1													
Notifera sp.																		
TOTAL NO. PER ML.	451	948	599	807	4,983	1,979	1,135	11	49	110	47	33	126	113	1,114	1,866	611	213
TOTAL NO. PER SQ. CM.	90.7	171.2	107.3	139.3	900.8	10.0	20.5	2.0	3.6	12.9	7.6	5.9	0.3	20.8	207.0	468.3	221.1	123.1

Table No.5 Qualitative Plankton Analyses - Zanzibar, South Kabula (Contd.)

	9/6/56	9/13/56	9/20/56	9/26/56	10/4/56	10/10/56	10/18/56	10/24/56	11/1/56	11/8/56	11/15/56	11/21/56	11/29/56	12/5/56	12/11/56	12/19/56	12/27/56
PHYTOPLANKTON																	
BLUE-GREEN ALGAE																	
Chroococcus																	
Gomphosphaeria-Coelosphaerium gr.																	
Merismopedia punctata	3																
Nostocaceae-spore																	
Oscillatoria gr.					1	1			1								
Rivularia gr.													1				
DIATOMS																	
Biddulphia (a)	190	137	31	3	4	1	2	1				1					
Bulbosa (b)	1	11															
Cyclotella-Stephanodiscus gr.	288	465	156	23	30	10	18	7	11	10	3	18	16	20	1	11	16
Cyclotella (a)	37		36				14			3		1					
Diploneis gr.	86				18		9	2	3	2	13	15	23	33		11	
Ehantoceros																4	
Diatoma elongatum			28														
Diatoma vulgare					13				2	3		20	10	17	5	3	5
Fragilaria spp.		8		2				4	11	5		6	18	25	4	8	8
Asterionella																1	1
Synedra gr.		148										8		1			2
Melosira/Aulo				1											1		
Gyrosigma gr.	1					1				1							
Navicula gr.	97		41		74	5	24	16	38	119	47	12	75	15		27	14
Cymbella							2		1	4		2	1	1			
Amphora gr.					1				1				1				
Pleurosigma viridis																	
Rhopalodia		4		3		1			3			4	1		1	1	2
Cymatopleura	3				3							8					
Surirella																	
Bitzschia gr.	3	4	1	3	7	3	1	1		2	1	2	3		7	1	4
Asterolia												3			1		4
GREEN ALGAE																	
Chlamydomonas gr.				4	4			1					1	1	1	4	4
Pandorina morum																	
Oocystis	95		8		2	2	4	16	5	2	7		1	7		4	
Sphaerocystis						6									1		
Elakatothrix																	
Microspora									1			4	1	1		1	
Ankistrodesmus							17	27	7	1	19	14	8	4		1	
Stigeoclonium																	
Pediastrum duplex	4			2	1			1		1						1	
Pediastrum simplex										1			1				
Pediastrum boryanum			9							1							
Pediastrum integrum								2									
Coelastrum sphaericum																	
Coelastrum sp.	1		2		3		2	4	2	1	3	8		1			
Chlorella			15					3			2	4					
Dictyosphaerium	42		20				1	2									
Closteriopsis		2	1	3	20	7	3	2		4			3				
Ankistrodesmus	41		20		1		3		1		3	2	4	13		14	
Schroederia													1				
Kirchneriella contorta																	
Oocystis sp.																	
Tetraedron										1							
Scenedesmus acuminatus			1														
Scenedesmus bijuga			8		3	1		2	1		3	7	1	2		4	
Scenedesmus disciplus	14		17		1						1	1				1	
Scenedesmus quadricauda	14	2	27		3	1			2	1	2	3	1	1		2	
Crucigenia quadrata								3	10		32	24	10	4		8	
Crucigenia rectangularis															1		
Crucigenia sp.					4		1			10							
Arthrodesmus			1														
Tetraedron staurogeniaeforme								1			2						
Desmarium sp.			3		1		2	1									
EUGLENOPHYTA																	
Euglena sp.							1	1				3	1			4	
Phacus sp.			1														
Trachelomonas sp.									4				2		1		
CYANOPHYTA-BLUE ALGAE																	
MICROPHYTALS																	
Gomphosphaeria sp.																	
Merismopedia sp.																	
DINOFLAGELLATA																	
PERIDINIALES																	
Centrogyrale cohnicata																	
Difflugia urceolata						1											
DICTYOTALES																	
Polyarthra platyptera																	
Ditifera sp.																	
TOTAL No. PER ml.	963	999	442	49	158	40	160	98	118	171	138	189	181	124	33	140	93
TOTAL No. (EXCEPT BLUE ALGAE) PER ml.	675.9	189.6	61.3	11.6	39.5	9.0	12.0	11.6	9.5	19.1	8.8	15.3	16.1	8.1	6.6	8.9	7.0

Table 1a6.[1] Individual Plankton Analyses - Beach 75. Pendell Cove

	1/[illegible]	[illegible]/1/5	1/[illegible]/5	1/[illegible]/5	2/1/54	2/8/54	2/15/54	2/22/54	2/25/54	3/1/54	3/8/54	3/16/54	3/22/54	3/29/54	4/5/54	4/12/54	4/[illegible]/54	4/26/54
PHYTOPLANKTON																		
BLUE-GREEN ALGAE																		
Chroococcus									1	1								
Coelosphaerium-Gomphosphaeria gr.		1																
Dactylococcopsis																1		2
Oscillatoria gr.																		3
Aphanizomenon																		
YELLOW-GREEN ALGAE																		
DIATOMS																		
Melosira (a)																		
Melosira (b)																		
Cyclotella-Stephanodiscus gr.		1				1						16	12					1
Cyclotella (a)	2			1								20	36	9		1		1
Rhizosolenia gr.			1	1	1		3	1	11	13	38	79	16	22	32	27	15	
Diatoma elongatum			2	8	12	9	7	2	8	20	15	31	181	221	266	327	313	
Diatoma vulgare													1	1		3	1	
Fragilaria crotonensis																		
Asterionella	13	39	58	116	187	99	49	19	170	140	178	229	66	27	61	21	82	
Synedra gr.	1		3	5	12	1	6	3	3	3	25	53	88	58	118	79	86	
Navicula gr.																		
Gomphonema gr.																1		
Nitzschia gr.				3	3							1			1	1	6	2
Surirella										1	3		9	7	13	49	73	
EUGLENOPHYCEAE																		
Peteromitrichales sp.	5	16	27	61	27	1	24	4	38	39	4	92	3		4		3	
CHRYSOPHYCEAE																		
Dinobryon sertularia												1	1					
Mallomonas sp.																		
GREEN ALGAE																		
Chlamydomonas gr.	24	103	93	93	79	39		1				2				3	2	
Eudorina elegans																		
Oocystis	2	1	1				1	1						1				
Sphaerocystis		1					1											
Elakatothrix																		
Stichococcus																		
Botryosphaerium		1	1		1	2												
Westella	2	2		2	1													
Closteriopsis			1															
Ankistrodesmus	1	1		1							1	3	1		1		3	2
Schroederia					1													
Selenastrum																		
Dimorphococcus																		
Scenedesmus dimorphus	1	2	1															
Scenedesmus quadricauda							1											
Crucigenia quadrata																		
Crucigenia tetrapedia																		
Crucigenia sp.																		
Actinastrum	2	3	2	2														
Tetraedron staurogeniaeforme			1															1
Closterium sp.																		
Cosmarium sp.																		
EUGLENOPHYTA																		
Euglena sp.	10	17	13	10	17	11	1	3	6	4	19	18	1	4		13	2	
Trachelomonas sp.				2														
YELLOW-BROWN ALGAE																		
Gymnodinium	3	18	30	13	13	17		3			3	3						
Peridinium					1		2				3	3	2					
Ceratium																		
ZOOPLANKTERS																		
PROTOZOA																		
Difflugia urceolata																		
Halteria				1									1					
Vorticella																		
Ciliata sp.	2	6	6	1	9	3	2	10	17	7	4	5	1	6	2	3	3	
ROTIFERA																		
Polyarthra platyptera																		
Philodina sp.																		
Synchaeta sp.																		
Trichocerca sp.																		
Rotifera sp.							2								1			
CRUSTACEA																		
Diaptomus																		
Nauplii (Crustacea)														1				
TOTAL NO. PER ML.	68	139	176	324	348	206	106	39	224	118	333	684	398	370	390	542	596	
TOTAL MG. UNITS PER ML.	9.1	11.6	13.2	18.4	30.1	23.1	12.9	6.9	30.2	34.8	46.4	83.3	68.4	68.3	137.3	138.1	107.3	

Table 1a[2] Individual Plankton Counts - Major Fl. Pumpkin Run (Cont'd.)

	5/3/54	5/10/54	5/17/54	5/24/54	6/1/54	6/7/54	6/14/54	6/21/54	6/28/54	7/6/54	7/12/54	7/19/54	7/26/54	8/2/54	8/9/54	8/16/54	8/23/54
PHYTOPLANKTON																	
BLUE-GREEN ALGAE																	
Chroococcus																	1
Oscillatoria gr.										1							
Anabaena-Coelosphaerium-Gomphosphaeria gr.										1							
Anabaenopsis	2	2															
Oscillatoria gr.								2		1							
Spirulina																1	
YELLOW-GREEN ALGAE																	
DIATOMS																	
Melosira (a)			1		1		1		1	1			4	41	76	156	187
Melosira (b)														1			
Cyclotella-Stephanodiscus gr.		8	5	40	290	1,833	736	18	9	13		9	2	52	76	468	81
Cyclotella (a)	1			2													
Rhizosolenia gr.	8	8		4												1	
Diatoma elongatum	140	74	10	571	85	34	3										
Diatoma vulgare		2						2								25	
Fragilaria crotonensis								2							1		2
Asterionella	240	138	183	1,171	410	217	42	10								1	
Synedra gr.	71	54	138	3,071	2,619	119	27	1					3			2	5
Coscinodiscus													2				
Navicula gr.				1												2	
Gomphonema gr.		3						1									
Nitzschia gr.	5			5	1			3	3	1	2	3			1		
Surirella	53	46	5	34	8											1	1
EUGLENOPHYCEAE																	
Heterotrichales sp.		2															
CRYPTOPHYCEAE																	
Hallomonas sp.			1														
GREEN ALGAE																	
Chlamydomonas gr.	3	4	3	3			1			5					1		
Ankistrodesmus falcatus	1	1															
Pleodorina					1												
Gloeocystis		2		7	3		2	1			1			1			4
Ophiocytium		1			1										2	1	1
Elakatothrix		2	1														
Oocystis		1															
Pediastrum duplex																1	
Coelastrum sp.							1								2		
Dictyosphaerium										2							
Quadrigula			1														
Closteriopsis											1			1	1		
Ankistrodesmus	1	4		5	1												1
Dictyosphaerium																	1
Golenkinia		1															
Dimorphococcus				2													
Lagerheimia sp.					2												
Scenedesmus arcuatus					2												
Scenedesmus dimorphus		2		1													
Scenedesmus opoliensis																	
Scenedesmus quadricauda		1		2			1										
Crucigenia quadrata																	
Crucigenia tetrapedia																	2
Crucigenia sp.		1															
Actinastrum																	
Tetrastrum staurogeniaeforme				1													
Closterium sp.																	
Cosmarium sp.																	
EUGLENOPHYTA																	
Euglena spp.	4	12		22	6		1	1	1		1		1			8	1
Trachelomonas sp.		1		1	1											2	2
YELLOW-BROWN ALGAE																	
Dinobryon	3	31		30													
Peridinium																	
Ceratium																	
ZOOPLANKTON																	
PROTOZOA																	
Difflugia urceolata		1	0	1													
Halteria																	
Vorticella	1	1		1													
Ciliate spp.	1	4		7	1		2										
ROTIFERA																	
Polyarthra platyptera		2															
Philodina sp.			1														
Synchaeta sp.			1														
Trichocerca sp.															1		
Keratella sp.																	1
CRUSTACEA																	
Nauplius																	
Copepoda (Juveniles)											1						
TOTAL NO. PER ML.	542	444	383	4,983	3,442	2,223	819	41	14	23	6	12	12	96	161	662	293
TOTAL MG. PER ML.	77.2	61.2	58.6	693.6	381.7	134.6	42.0	7.7	3.3	3.0	1.7	2.1	3.3	44.4	81.5	185.8	102.1

Table 144.[3] Individual Plankton Analyses - Baker Pt. Randall Lgn (Cont'd.)

	8/30/54	9/5/54	9/13/54	9/20/54	9/27/54	10/4/54	10/11/54	10/18/54	10/25/54	11/1/54	11/8/54	11/15/54	11/29/54	12/6/54	12/13/54	12/20/54	12/27/54
PHYTOPLANKTON																	
BLUE-GREEN ALGAE																	
Chroococcus										1							
Oscillatoria gr.									4								
YELLOW-BROWN ALGAE																	
DIATOMS																	
Melosira (a)	59	96	97	13	4	3	6	1		1							
Melosira (b)		5															
Cyclotella-Stephanodiscus gr.	18	128	211	89	5	7	4	3	2	1	4	10	88	80	86	32	27
Cyclotella (a)			2		1	4						20		1	5	3	2
Rhizosolenia gr.				1	2	1			2	1	2	2	18	40	86	12	57
Diatoma elongatum							1										
Diatoma vulgare							1			21	4	184	5				
Fragilaria spp.												12					
Asterionella															1	2	3
Synedra gr.	8	65	70	8												1	
Chaetoceros																	
Navicula gr.						3	2			1	2	12	4	3	1		6
Amphora									1	1							
Cymbella															1		
Gomphonema gr.										1		1			1		
Nitzschia gr.		1	3	1			3	1		148		15	3			4	
Surirella										2				1	1		
XANTHOPHYCEAE																	
Heterothrix.ce sp.																	
CHRYSOPHYCEAE																	
Hallomonas sp.													1	3	1		2
GREEN Algae																	
Chlamydomonas gr.							2	2	2		7		7	3	14	3	3
Ankistrodesmus elegans																	
Flooderiae																	
Dictyosphaerium																	
Sphaerocystis																	
Stichococcus																	
Microspora																	
Pediastrum duplex																	
Scenedesmus spp.																	
Tetraedron																	
Lagerheimia sp.																	
Scenedesmus arcuatus																	
Scenedesmus bijuga																	
Scenedesmus dimorphus																	
Scenedesmus Opoliensis																	
Scenedesmus quadricauda																	
Crucigenia quadrata																	
Crucigenia tetrapedia																	
Crucigenia sp.																	
Actinastrum																	
Tetraedron staurogeniaeforme																	
Closterium sp.																	
Cosmarium sp.																	
EUGLENOPHYTA																	
Euglena spp.																	
Trachelomonas spp.																	
YELLOW-BROWN ALGAE																	
Gymnodinium																	
Peridinium																	
Ceratium																	
ZOOPLANKTON																	
PROTOZOA																	
Difflugia arcoolata																	
Halteria																	
Vorticella																	
Ciliate spp.																	
ROTIFERA																	
Polyarthra platyptera																	
Philodina sp.																	
Gymnetes sp.																	
Trichocerca sp.																	
Notifera sp.																	
COPEPODA																	
Nauplii																	
Bosmili (Juvenile)																	
TOTAL NO. PER ML.	86	300	382	86	31	48	30	19	35	373	118	385	373	216	252	140	200
TOTAL MG. DRY WT. PER ML.	60.3	117.6	65.6	18.3	8.6	6.1	14.0	3.5	8.8	185.0	5.7	85.8	9.7	7.6	9.1	7.9	10.1

Table 1Ap.[1] Individual Plankton Analyses - Ft. Randall Reservoir

	1/5/54	1/11/54	1/19/54	2/1/54	2/9/54	2/15/54	2/23/54	3/1/54	3/8/54	3/16/54	3/22/54	3/29/54	4/.../54	4/12/54	4/19/54	4/26/54	5/.../54
PHYTOPLANKTON																	
BLUE-GREEN ALGAE																	
Gomphosphaeria-Coelosphaerium gr.																6	
Dactylococcopsis														1			1
Oscillatoria gr.															4	3	
Nostoc gr.																	
Aphanizomenon																	
YELLOW-GREEN ALGAE																	
DIATOMS																	
Melosira (a)																	
Melosira (b)																	
Cyclotella-Stephanodiscus gr.		6								1	3				1	2	
Cyclotella (a)		1		1	1			2	3	4	63	5			6		
Ehizosolenia gr.	1							8	16	19	16	7	16	35	38	3	7
Diatoma elongatum		3		5	13	18		6	6	16	32	96	159	321	240	286	89
Diatoma vulgare												2	1	2	2		3
Fragilaria spp.								5									
Asterionella	75	56	1	132	273	304	1	116	149	175	178	65	36	57	41	58	103
Synedra gr.		1		5	9	17		9	3	19	40	75	99	163	88	71	75
Navicula gr.																1	
Gomphonema gr.																1	
Nitzschia gr.		1								2				2	2	2	7
Surirella		1								1	7	3	3	14	34	52	36
EUGLENOPHYCEAE																	
Heterotrichales sp.		25		3	1			20	32	4	7	6		8	6		2
CHRYSOPHYCEAE																	
Dinobryon sertularia								1	3							2	
GREEN ALGAE																	
Chlamydomonas gr.	77	54		157	27					1			1		6		3
Pandorina morum																	1
Ankistrodesmus																	
Gloeocystis		1		2				1					1				
Sphaerocystis	1																
Elakatothrix																	
Stichococcus																	
Pediastrum duplex																	
Dictyosphaerium	1			2	5	4										1	
Westella		8	1	3											1		
Schroederia				1													
Cosmarium																	
Ankistrodesmus	4		1			2		1	2	2				3			2
Lagerheimia subulata		1															
Closteriopsis							2								1		
Dictyosphaerium																	
Tetraedron																	
Tetrastrum staurogeniaeforme		1			1										1		1
Scenedesmus bijuga					1												
Scenedesmus dimorphus				2	1												1
Scenedesmus quadricauda														1			
Crucigenia quadrata		2															
Crucigenia tetrapedia																	
Crucigenia sp.																	
Actinastrum	2	4		1				1									
Closterium sp.																	
EUGLENOPHYTA																	
Euglena spp.	13	2		29	13	9		4	12	6	8		6	13	5		2
Trachelomonas spp.				1	2											1	1
YELLOW-BROWN ALGAE																	
Gymnodinium																	
Peridinium						1		2		1	2		1		1		
ZOOPLANKTON																	
PROTOZOA																	
Diffugia urceolata					1												
Halteria		13															
Vorticella	1											2	4				
Ciliata spp.	4			8	6	12		14	9	12	6			3	8		3
ROTIFERA																	
Brachionus sp.																	1
Keratella cochlearis																	
Polyarthra Platyptera																	
Rotifera spp.	1				2	1											
COPEPODA																	
Nauplii (Juveniles)																	
CLADOCERA SP.																	
TOTAL NO. PER ML.	123	176	3	434	357	440	3	190	295	361	392	293	387	501	479	460	382
TOTAL "M" UNITS PER ML.	3.6	13.8	0.2	44.4	40.8	84.1	1.1	27.0	34.8	42.3	40.6	40.2	57.9	107.8	85.8	97.2	84.6

Table 14a.[2] Individual Plankton Analyses - Ft. Randall Reservoir (Cont'd.)

	5/10/54	5/20/54	6/1/54	6/7/54	6/14/54	6/21/54	6/25/54	6/28/54	7/6/54	7/12/54	7/19/54	7/26/54	8/2/54	8/9/54	8/16/54	8/23/54	8/30/54
PHYTOPLANKTON																	
BLUE-GREEN ALGAE																	
Gomphosphaeria-Coelosphaerium gr.									1	3	1					1	
Dactylococcopsis	1			1													
Oscillatoria gr.		2															
Nostoc gr.	1																
Aphanizomenon				1													
YELLOW-GREEN ALGAE																	
Diatoms																	
Melosira (a)			1	4								3	30	107	206	154	134
Melosira (b)														1			
Cyclotella-Stephanodiscus gr.	4	43	190	2,761	598	22		11	2	1	1	5	18	124	695	44	31
Cyclotella (a)																	
Rhizosolenia gr.	7	6														1	
Diatoma elongatum	30	574	82	54	8		2								3		
Diatoma vulgare																	
Fragilaria spp.														1			
Asterionella	123	1,086	298	249	56	12	156										
Synedra gr.	72	2,801	1,178	172	9		4			1	1	1			4	7	19
Navicula gr.																1	
Gomphonema gr.											1						
Fittschia gr.	3	1	3	5					1	1	2					1	1
Surirella	48	22	8	1							1						
EUGLENOPHYCEAE																	
Heterotrichales sp.	1	6					43										
CHRYSOPHYCEAE																	
Dinobryon sertularia		1															
GREEN ALGAE																	
Chlamydomonas gr.	4	3	2				243	1				1		3			
Pandorina morum	1	1															
Eudorina					1												
Gloeocystis	1	3		2	1	2	3	7			2	6		2	3		1
Sphaerocystis		1				2			1								3
Elakatothrix																	
Dictyosphaerium													1	1			
Pediastrum duplex			1			1											
Westella							3										
Oocystis sp.							1	1								1	1
Schroederia																1	1
Coccoid															1		
Ankistrodesmus	4	6	3	7			2	1									2
Lagerheimia subsalsa																	
Closteriopsis												2		1			
Dimorphococcus		2															
Tetraedron																	
Tetrastrum staurogeniaeforme		1	2				1										
Scenedesmus bijuga															7		
Scenedesmus dimorphus				1	1												
Scenedesmus quadricauda		11	3	2			1					3				2	2
Crucigenia quadrata					12			1									
Crucigenia tetrapedia		2															
Crucigenia sp.							1										
Actinastrum	1	1					2										
Closterium sp.																	
EUGLENOPHYTA																	
Euglena spp.	33	42	17		2		20	3		2	1				1	1	2
Trachelomonas spp.		1											2	4	2	2	2
YELLOW-BROWN ALGAE																	
Gymnodinium																1	
Peridinium	1																
MISCELLANEOUS																	
FLAGELLATA																	
Dinflagia crenulata	1	1															
Salpingoeca																	
Vorticella	1																
Ciliata spp.	23	3					6			2	1					2	
ROTIFERA																	
Brachionus sp.	1																
Keratella cochlearis																	
Polyarthra platyptera																	
Rotifera spp.	1					1											
CRUSTACEA																	
Nauplii (Cyclops)				1													
CLADOCERA sp.																	
TOTAL NO. PER ML.	399	6,542	1,788	3,339	684	38	496	27	3	16	11	23	51	344	921	220	220
TOTAL MG. DRY WT. PER ML.	54.3	640.0	212.0	173.9	33.4	4.8	56.9	1.1	0.8	1.2	1.7	4.6	30.7	113.4	234.9	150.8	138.5

Table 14a.[3] Individual Plankton Analyses - Ft. Randall Reservoir (Cont'd.)

	9/6/54	9/15/54	9/25/54	9/29/54	10/4/54	10/11/54	10/18/54	10/25/54	11/1/54	11/8/54	11/15/54	11/29/54	12/6/54	12/13/54	12/20/54	12/27/54
PHYTOPLANKTON																
BLUE-GREEN ALGAE																
Gomphosphaeria-Coelosphaerium gr.				1				1								
YELLOW-GREEN ALGAE																
DIATOMS																
Melosira (a)	110	42	12	2	1	1	1	2								
Melosira (b)																
Cyclotella-Stephanodiscus gr.	175	80	50	2	8	2	6	2	2	29	10	17	46	49	50	16
Cyclotella (a)			3		1						40				1	2
Rhizosolenia gr.			9				1			5			36	51	9	23
Diatoma elongatum																
Diatoma vulgare												1		2		20
Fragilaria spp.																
Asterionella															1	2
Synedra gr.	92	48													2	
Navicula gr.				1	3							2	1	2		2
Gomphonema gr.											1					
Nitzschia gr.						1	1		1						2	1
Surirella															1	2
EUGLENOPHYCEAE																
Heterotrichales sp.																
CHRYSOPHYCEAE																
Dinobryon sertularia																
Mallomonas sp.												2	1	1		5
GREEN ALGAE																
Chlamydomonas gr.							1	4	3	1		4	4	3	9	5
Pandorina morum																
Eudorina																
Gloeocystis	1			2	5	3	3	16	6	11	25	8	11	16	10	13
Sphaerocystis						3	10	12	4		8				1	
Elakatothrix											3				1	
Ulothrichaceae					1		3	9	12	7	11	3	20	10	4	4
Oedocystis duplex							1	1					1			
Dictyosphaerium											3			2		1
Westella	2														2	
Coelastrum sphaericum			1	3												
Coelastrum sp.					1	3			3	17	4	2		1	1	2
Chlorella			4							11	22	4	55	30		2
Schroederia				1												
Oocystis											1					
Ankistrodesmus									1		1	2	27	11	4	36
Lagerheimia subsalsa																1
Closteriopsis		2	4	2	2					2		1				
Dictyosphaerium						1										
Tetraedron											1					1
Tetrastrum staurogeniaeforme							1	1	2				1	1	6	
Scenedesmus bijuga	2							4		1	6		2			1
Scenedesmus dimorphus								2			2		1			
Scenedesmus quadricauda							2		1	2	11	1	6	2	1	2
Crucigenia quadrata						1		2	4		29		13	22		25
Crucigenia tetrapedia											4		2			1
Crucigenia sp.							1			2						
Actinastrum																
Closterium sp.							1	2	1							
DINOPHYCEAE																
Peridinium spp.						1	6	11	10	11	7	17	36	22	10	22
Trachelomonas spp.	2	1		1		2	2					2	2	11	6	10
YELLOW-BROWN ALGAE																
Cymbella sp.						1									2	
Fragilaria									1							
PROTOPLASTINS																
PROTOZOA																
Difflugia urceolata																
Halteria																
Vorticella																
Ciliata spp.	1					1	2	2	1						4	
ROTIFERA																
Brachionus sp.																
Keratella cochlearis								3								
Polyarthra platyptera	1	1														
Notifera spp.																
COPEPODA																
Nauplii (Juvenile)		1														
CLADOCERA SP.													1			
TOTAL NO. PER ML.	406	182	85	13	23	21	64	76	54	100	197	68	270	253	136	150
TOTAL NO. UNITS PER ML.	126.2	51.0	10.9	3.3	3.0	2.3	3.3	8.7	4.1	3.1	6.2	3.9	12.1	8.2	7.7	5.2

Table 16.[illegible] Individual Diatom Analyses - Shambleau, South Dakota

	1/5/54	1/11/54	1/19/54	1/26/54	2/1/54	2/8/54	2/16/54	2/22/54	3/1/54	3/8/54	3/15/54	3/23/54	4/7/54	4/11/54	5/4/54
PHYTOPLANKTON															
BLUE-GREEN Algae															
Chroococcus												1	1		
Gomphosphaeria-Coelosphaerium gp.												3	3		
Merismopedia glauca												3	3		
Oscillatoria gp.			1									9	9	1	
Spirulina												8	8		
Unidentified												4	1		
YELLOW-GREEN Algae												3	3		
Diatoms												7	7		
Amphora gp.												9	9		
Amphora (a)												8	5		
Amphora (b)												3	3		
Cymatopleura-Epithemia gp.												4	4		
Cymbella (a)												1	1		
Cymbella gp.	4			1			1	2	2			6	6		2
Diatoma elongatum												3	3		
Diatoma vulgare												1	1		2
Fragilaria crotonensis															
Fragilaria spp.															
Gomphonema gp.			2												
Gyrosigma gp.															
Navicula gp.	2								1		1				2
Nitzschia gp.							1		1						
Rhoicosphenia curvata			2												
Stephanodiscus astraea												7	7		
Stephanodiscus gp.	1			1	1			1	1		5				4
Surirella											1				2
EUGLENOPHYCEAE															
Heteronema sp.															
CRYPTOPHYCEAE															
Rhodomonas minuta															
Unidentified sp.															
GREEN Algae															
Chlamydomonas gp.	2	3	3	3	3	1	1		3		3				3
Pandorina morum															
Oocystis															
Sphaerocystis															
Ankistrodesmus															
Dictyosphaerium															
Pediastrum boryanum															
Pediastrum duplex															
Scenedesmus quadricauda															
Scenedesmus sp.															
Staurastrum sp.															
Chlorella															
Ulothrix															
Unidentified sp.															
Actinastrum															
EUGLENOPHYTA															
Euglena pisciformis															
Euglena sp.			1								1				1
Phacus longicauda															
Phacus sp.															
Trachelomonas sp.					1										
DINOFLAGELLATES															
PERIDIN															
Diflugia oviformis															
Tortonella															
ROTIFERA															
Trochosphaera sp.															
Collotheca sp.															
Philodina sp.															
TOTAL NO. PER ML.	10	3	11	5	5	1	4	3	9	1	8			1	13
TOTAL NO. PER 0.04 MM SQ.	1.0	0.3	1.1	0.5	0.5	0.1	0.4	0.3	0.9	0.1	0.8			0.1	1.3

Table 147.[3] Individual Plankton analyses - Chamberlain, North Dakota (Cont'd.)

PHYTOPLANKTON	5/18/54	5/25/54	6/1/54	6/9/54	6/15/54	6/22/54	6/29/54	7/6/54	7/13/54	7/20/54	7/26/54	8/3/54	8/9/54	8/16/54	8/26/54
BLUE-GREEN ALGAE															
Chroococcus	1														
Gomphosphaeria-Coelosphaerium gr.	1							1	3					3	
Anabaenaceae														1	
Aphanizomenon			3			1		12	4			1			
Oscillatoria gr.	1	2		1		9	5	8	9	9	5	3	3		2
Lyngbya											3				
Nostoc gr.							1	3	4			3			
Aphanizomenon									3						
YELLOW-GREEN ALGAE															
DIATOMS															
Melosira (a)							1	8	26	79	30	2	1	3	4
Melosira (b)													3		1
Cyclotella-Stephanodiscus gr.	305		3			22	89	91	33	81	9	6	19	89	34
Cyclotella (a)															
Stephanodiscus astraea													2	3	
Rhizosolenia															
Diatoma elongatum	16	2					3	13	7	1	4	2			
Diatoma vulgare															
Fragilaria crotonensis										4					
Fragilaria spp.															
Asterionella	117	224	1			65	42	868	5	229	11		2	1	14
Synedra gr.	37	135				3				3	1	2			
Cyrtolepa gr.									1						
Surirella gr.	1						1			2			2		
Gomphonema gr.															1
Diatoma gr.	3	2	3				2	10	3	2	3	2	2	1	3
Surirella	22	7				3									
EUGLENOPHYCEAE															
Heterotrichales sp.								1							
CHRYSOPHYCEAE															
Dinobryon sertularia															
Mallomonas sp.															
GREEN ALGAE															
Chlamydomonas gr.		465				3	1	3	3				1		
Pandorina morum							1								
Glenocystis									1			2	2	2	22
Sphaerocystis							1							1	
Elakatothrix						2									
Ctenocystis									1						
Pediastrum boryanum										1					1
Pediastrum duplex							1	1		1				1	1
Coelastrum sphaericum									1						
Coelastrum sp.						2									
Dictyosphaerium									1						
Chlorella															
Dispora															
Lagerheimia sp.															
Ankistrodesmus	1														
Closteriopsis						6		3	2	4	2	1	1	2	2
Scenedesmus							1	7	3	2				1	
Oocystis															4
Kirchneriella								2					4		
Tetraedron elongatum															
Tetraedron stauroneiformes							1								
Scenedesmus bijuga									1					2	4
Dictyosphaerium dimorphum	1						1	1						1	
Scenedesmus acutiformis															
Scenedesmus quadricauda	1							2		1		2			
Crucigenia quadrata															
Crucigenia sp.															
Actinastrum	2					3	2	2	4	1					
EUGLENOPHYTA															
Euglena pisciformis															
Euglena sp.	1						1	1							2
Phacus longicauda															1
Phacus sp.															
Trachelomonas spp.			2				1		1						
EUGLENOPHYTA															
PROTOZOA															
Difflugia oreselata															1
Vorticella	2														
ROTIFERA															
Brachionus sp.								1							
Collotheca sp.								1							
Philodina sp.													1		
TOTAL NO. PER ML.	533	6,7	12	1	119	86	304	330	208	94	27	68	154	88	
TOTAL NO. UNITS PER ML.	97.7	61.0	2.1	1.0	85.7	19.3	77.3	43.9	121.8	38.6	9.3	34.0	38.3	37.6	

Table 1of.3 [illegible]

[illegible]																
[illegible]																
[illegible]																

Table 14g.[illegible] Individual Plankton Analyses - Pierre, South Dakota

	3/5/54	3/9/54	3/19/54	3/30/54	4/3/54	4/16/54	4/23/54	5/25/54	6/8/54	6/17/54	6/24/54
PHYTOFLAGELLATES											
BLUE-GREEN ALGAE											
Anabaena-Gloiotrichia gp.											
Anacystis cyanea											
Aphanizomenon											
YELLOW-GREEN ALGAE											
DIATOMS											
Melosira (a)		1		1							5
Cyclotella-Stephanodiscus gp.											1
Cyclotella (a)		1		1	1	10		7	35	7	3	33
Rhizosolenia gp.	2			2		1			1	35	1	4
Diatoma elongatum												8
Fragilaria crotonensis												
Asterionella	2									67		267
Synedra gp.												10
Gyrosigma gp.												
Navicula gp.				13	1					13		1
Cymbella												
Cymatopleura												
Nitzschia gp.										4		1
Surirella								1	4	4		2
EUGLENOPHYCEAE												
Heteronema sp.										13		
CRYPTOPHYCEAE												
Rhodomonas ovalis												
GREEN ALGAE												
Chlamydomonas gp.	7	1		4	4	1	1	1			1	1
Gloeocystis	9			2							4	
Sphaerocystis												1
Elakatothrix												
Dictyosphaerium												
Micrasterias												
Pediastrum boryanum												
Pediastrum duplex												
Scenedesmus quadricauda												
Scenedesmus sp.								1				
Staurastrum												
Tetraedron												2
Ankistrodesmus	1	2		1	1			1		36		
Closteriopsis												2
Oocystis												4
Selenastrum												1
Staurastrum												
Tetraedron minimum												
Tetraedron regulare												
Staurodesmus bidens												
Staurodesmus dickiei												
Scenedesmus quadricauda									1			
Crucigenia quadrata										3		
Crucigenia tetrapedia												
Crucigenia sp.												
Actinastrum										2		10
Dimorphococcus												
EUGLENOPHYTA												
Euglena sp.	1											
Phacus sp.												
Trachelomonas armata												
Trachelomonas sp.		2		1	3		1	3	1	9	1	6
MYXOPHYTA												
MYXOPHYCEAE												
Diffugia urceolata												1
Tortirella								2				
MYXOPHYTA												
Merismopedia punctata									1			
Oscillatoria sp.		1										
CHLOROPHYTA						1						
TOTAL NO. PER ML.	23	8		25	10	20	3	16	52	168	13	379
TOTAL MG. WET WT. PER ML.	1.1	0.3	0.0	0.9	0.1	0.7	0.08	0.9	3.3	10.1	0.7	50.0

Table 14a.[2] Individual Phytoplankton Analyses - Pierre, S.D. 1956 (Contd.)

	7/7/56	7/22/56	8/5/56	8/12/56	9/1/56	9/18/56	9/27/56	10/11/56	10/25/56	11/9/56	11 a/56	12/16/56
PROTOPLASMIDAE												
BLUE-GREEN ALGAE												
Gomphosphaeria-Coelosphaerium gr.	1											
Dactylococcopsis	6											
Coelosphaerium gr.			12							1		
Aphanizomenon	3		1	1				1	1	2		
YELLOW-GREEN ALGAE												
DIATOMS												
Melosira (a)	72	13	1	8	18	1	1	1				
Cyclotella-Stephanodiscus gr.	49	3	12	64	156	49	43	13	80	93	4	3
Cyclotella (a)									1			3
Entomoneis gr.	9	2	3	4	5	4	1	5	5	11	2	1
Diatoma elongatum									3			
Fragilaria crotonensis					4	1	2			1	2	1
Asterionella	631	15	3	30	71	21	2	11	64	149	250	118
Synedra gr.	8									1		
Gyrosigma gr.								1	2	1		
Navicula gr.	6	5	9	18	14	13	14	29	19	14	6	1
Cymbella		1						1				
Cystopleura			1									
Nitzschia gr.	17	12	1	1		7		8	4	7		1
Surirella			1								1	1
EUGLENOPHYCEAE												
Heterotrichales sp.												
CHRYSOPHYCEAE												
Dinobryon sertularia											1	
GREEN ALGAE												
Chlamydomonas gr.	1						1	8		2	5	11
Gloeocystis	5		9		1	24	5	2	10	14	10	13
Sphaerocystis			3						13	12		
Elakatothrix	2									2		
Staurastrum			1					4	7	9		
Microspora												15
Pediastrum boryanum	1											
Pediastrum duplex	1					1						
Oocystrum cambricum	2											
Oocystrum sp.					3	2	1					
Dictyosphaerium	3				1			1		1		
Chlorella						1					1	1
Ankistrodesmus					2	1	1			1		2
Closteriopsis	1	1	1	4	7	1	1	3		1		
Schroederia	11	2	3			2				1		2
Selenastrum	1											
Dispora					1							
Tetrastrum elegans												1
Scenedesmus bijuga	1		10	3	12	7				2		
Scenedesmus dicorphus						2			2			
Scenedesmus quadricauda	2				2			1				1
Crucigenia quadrata										10	7	4
Crucigenia tetrapedia											1	
Crucigenia sp.									5			
Actinastrum	6							2	4	1	2	4
Closterium						1						
EUGLENOPHYTA												
Euglena spp.						1		1	4	1	6	11
Phacus sp.						1						
Trachelomonas urceolata	2											
Trachelomonas sp.	1					1	2	7				3
DINOFLAGELLATA												
PERIDINIA												
Diflugia urceolata												
Vorticella												
MOTILES												
Rotatella quadrata												
ORGANISMS SP.							1					
RHIZOPODA												
TOTAL NO. PER ML.	822	34	73	133	245	136	82	97	232	330	297	245
TOTAL NO. CELLS PER ML.	313.3	29.8	59.0	88.3	93.1	24.7	5.8	18.7	83.2	93.3	58.3	29.3

Table 14b. Individual Plankton Analyses - Mobridge, South Dakota

	8/27/54	9/13/54	9/27/54	10/11/54	11/1/54	11/15/54	12/13/54
PHYTOPLANKTERS							
BLUE-GREEN ALGAE							
Coelosphaerium-Coelosphaerium gr.	3						
Microcystis sp.	1						
Aphanizomenon	5				1		1
YELLOW-GREEN ALGAE							
DIATOMS							
Melosira (a)	7	7	2				
Melosira (b)	5						
Cyclotella-Stephanodiscus gr.	48	51	83	7	93	22	1
Stephanodiscus astraea	2						
Rhizosolenia gr.		5	8		4	3	
Diatoma vulgare					1		
Fragilaria crotonensis		2	21				
Asterionella	16	35		19	71	272	144
Synedra gr.				3	3	1	
Navicula gr.	2	7	23		6	4	
Cymatopleura					1		
Nitzschia gr.	2	2	2	8	1		
CRYPTOPHYCEAE							
Mallomonas sp.						1	
GREEN ALGAE							
Chlamydomonas gr.	8			5		7	3
Glococystis	9	21	18	3	4	3	4
Stichococcus			6		11	12	
Microspora							8
Pediastrum duplex		2	1				
Coelastrum sp.		3	5		1	2	
Dictyosphaerium		2				1	2
Chlorella	1		1				
Schroederia	1	5	2				
Closteriopsis		1			3	1	
Ankistrodesmus		1			1	5	5
Dispora		1					
Scenedesmus bijuga	1	4	5				
Scenedesmus dimorphus		5	1			2	
Scenedesmus opoliensis							1
Scenedesmus quadricauda	2		3			2	
Crucigenia quadrata						12	2
Crucigenia sp.					12		
Actinastrum					3	3	2
EUGLENOPHYTA							
Euglena spp.	1		7		2	6	7
Trachelomonas sp.			1				2
YELLOW-BROWN ALGAE							
Ceratium	1						
ZOOPLANKTERS							
ROTIFERA							
Polyarthra platyptera	1						
TOTAL NO. PER ML.	116	154	191	45	219	359	183
TOTAL "S" UNITS PER ML.	20.9	25.1	21.3	9.3	22.7	58.4	30.1

Table 1a/. Individual Plankton Analysis - Sample: Delta Jewels

	7/28/54	8/2/54	8/9/54	8/23/54	9/8/54	9/15/54	9/22/54	9/29/54	9/27/54	10/4/54	10/11/54	10/18/54	10/25/54
PHYTOPLANKTON													
BLUE-GREEN ALGAE													
Chroococcus							1						
Merismopedia punctata									1				
Gomphosphaeria-Eu. aphanizomenoides gr.					1								
Dactylococcopsis	1												
Oscillatoria gr.						2							4
Lyngbya							1						
Anabaena gr.						4							
Aphanizomenon	15	17	12	6	9		8	1		7			
YELLOW-GREEN ALGAE													
DIATOMS													
Melosira (a)	1		6	2	4	11	3	1	1	1			
Cyclotella-Stephanodiscus gr.	1		2	37	11	46	42	19	59	7	18	11	4
Cyclotella (a)									2	2		1	
Stephanodiscus astraea					4	16							
Rhizosolenia gr.	2				1	1	2	4	46	1	20	7	
Diatoma elongatum													
Diatoma vulgare						4		1	3				
Fragilaria crotonensis					1	4					1		
Fragilaria spp.			1						10		4		
Asterionella	2	3	3	8	39	94	10	3		9	35	16	19
Synedra gr.										1			
Cocconeis		2											
Gyrosigma gr.				1		1					1		
Nitzschia gr.		4			4	3	6	8	70		18		
Cymbella							1						
Rhizosolenia gr.	3	4	4	2	1		3	15	9	3	2	4	
Surirella													
EUGLENOPHYTA													
Heterotrichales sp.													
CRYPTOPHYTA													
Rhodomonas ovalis/caudata													
GREEN ALGAE													
Chlamydomonas gr.				1	1	1				1	1	1	2
Closterella	2			11	2	12	6	14	21	0	23		
Ophiocytium		6				1							
Ankistrodesmus		2	2										
Stichococcus								2	18	0	100		
Microspora													
Pediastrum boryanum							1						
Pediastrum duplex	1					1			1				
Pediastrum integrum					1	1							
Coelastrum sphaericum		2			1		3	3	6		1	1	
Dictyosphaerium						3	1	1	2		3		
Chlorella							1	1	3				
Closteriopsis	1					2			4		1		
Ankistrodesmus							1		1		2	2	1
Gonyaulax	1												
Schroederia	4		2	4	4	4			2	1		2	
Lagerheimia sp.													
Tetraedron sp.								1					
Scenedesmus bijuga			2	1		1	3	2	7		3		
Scenedesmus disciformis						1			3		2		
Scenedesmus opoliensis													
Scenedesmus quadricauda			2					2	7	1	1	1	
Crucigenia quadrata													
Crucigenia rectangularis													2
Crucigenia sp.								4	4				
Actinastrum							1		2		3		
EUGLENOPHYTA													
Euglena acus													1
Euglena ehrenbergii						1							
Euglena sp.												1	
Phacus sp.						1		1					
Trachelomonas spp.								1	1	1		1	1
DINOFLAGELLATES													
PERIDINIALES													
Peridinium circulatum						1							
Peridinium globulus										1			
CRYPTOPHYTA													
Cryptomonas platyuris	1												
EUGLENOPHYTA SPP.				1									
CHLOROPHYTA													
Nephrocytium eremosum		1											
TOTAL NO. PER ML.	39	41	34	74	83	219	84	96	303	42	240	59	40
TOTAL NO. PER PER ML.	8.2	3.6	9.3	9.6	20.1	39.8	8.3	7.8	28.0	8.0	21.1	9.9	10.3

Table no. [illegible] Individual Plankton Analyses - Number, Harbor Basin (Cont'd.)

	11/1/54	11/8/54	11/15/54	11/29/54	12/6/54	12/13/54	12/20/54	12/27/54
PHYTOPLANKTON								
[illegible]								
[illegible]								
Coscinodiscus								
Corethron pennatum								
Ditylum brightwellii								
Eucampia zodiacus								4
Guinardia flaccida		2						
Lauderia								
Rhizosolenia								
Skeletonema								
[illegible]								
Bacteriastrum								
Chaetoceros (a)								
Chaetoceros compressum gr.	23	11	18	1	5	12	7	5
Chaetoceros (a)			3	1		1		
Chaetoceros setosum								
Detonula confervacea	6	1	5				10	1
Leptocylindrus danicus			2	2			5	1
Nitzschia closterium	1			5				
Rhizosolenia robustum		2						
Thalassiosira sp.							6	
Asterionella	57	158	124	158	111	840	440	930
Cerataulina gr.			1		1		1	1
Cocconeis								
Cyclotella gr.		1						
Navicula gr.	13	8	6	2		1	3	
Odontella						1		
Rhizosolenia gr.	3	3	2	14	7		6	1
Surirella		1	1	1		2	1	
DINOFLAGELLATES								
Heterocapsa sp.							17	6
CHRYSOMONADS								
Dinobryon sertularia		1	1					
GREEN ALGAE								
Chlamydomonas gr.				1	5	83	13	5
Dictyosphaerium	4	3	17			8		3
Ophiocytium								
Scenedesmus		2				2		
Stichococcus	2	1	0			1		
Tetraspora						4		
Pediastrum tetraeum								
Pediastrum duplex								
Pediastrum integrum								
Scenedesmus obliquus	1		1					
Dictyosphaerium		1						1
Chlorella						2		1
Closteriopsis								
Gonyostomum	0	3	3	1		3	5	5
Euglypha								
Trachelomonas	1							
Euglenaria sp.						1		
Tetraedron sp.								
Scenedesmus bijuga	2	1					1	
Scenedesmus dimorphus	1		1		1	2	1	
Scenedesmus opoliensis							2	
Scenedesmus quadricauda		1	1				1	
Oocystis gracilata		10	9			6	23	7
Oocystis rectangularis				2				
Oocystis sp.	2							
Ankistrodesmus	1	3	1			2	3	2
EUGLENOPHYTA								
Euglena acus								
Euglena acutissima								
Euglena sp.	3	1	4	2	1	4	3	
Phacus sp.								
Trachelomonas sp.		1		1	1	2	2	1
PYRRHOPHYTA								
PERIDINIA								
Peridinium aciculiferum								
Peridinium globulus								
DIATOMEA								
Melosira granulata								
CHLOROPHYTA								
Closterium acerosum								
TOTAL NO. PER ML.	134	230	268	310	273	310	580	480
TOTAL NO. IN 25 PER ML.	10.1	186.0	29.9	41.3	30.1	34.0	56.9	84.3